The neighbourhood matters : the neighbourhood social environment and differences in self-reported quality of life and mental health

The Neighbourhood Matters

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Contents

Chapter 1

Introduction

There is accumulating evidence on both sides of the Atlantic that the shared social environment at the neighbourhood level exerts significant effects on mental health and quality of life of the persons living there, independent of their individual-level risk profile (Kalff et al., 2001, Van Os et al., 2000, Sampson et al., 1997, Coleman, 1990, Coleman, 1988). Since the publication of Robert Park's seminal paper in 1915 "The City: Suggestions for the Investigation of Human Behaviour in the City Environment" (Park, 1967), generations of "Chicago School" sociologists and their students have been documenting how neighbourhood-level ecological factors have affected social disorganisation and social cohesion, both in adults and children (Janowitz, 1952, Smith, 1988, Wirth, 1957, Shaw and McKay, 1969). More recent work introduced "social capital" as the umbrella term to refer to the capacity for resource mobilization and other 'prosocial' goals that constitute social organisation, social cohesion and related concepts (Kawachi et al., 1999b, Bourdieu, 1986).

For example, effects of social capital in socioeconomically deprived areas have been described decades ago in a group of Italian immigrants in Roseto, United States (Bruhn and Wolf, 1979). The Italian immigrants could only find economic opportunity for manual work with low salaries and, therefore, were forced to form a community in order to survive through supporting each other. This resulted in low rates of heart disease, but when the old community norms and values were no longer adhered to, the heart disease rates increased.

The current thesis studies neighbourhood effects of socioeconomic factors and lack of social resources (social capital), using data from the Maastricht Quality of Life Study (MQoL) and data on treated psychiatric morbidity. Outcomes of the MQoL are subjective psychological health measures in the general population, summarized as quality of life. While having been described exhaustively by sociologists, both social capital and quality of life concepts have been so widely used with so many different definitions that the concepts still remain vague. Therefore, to introduce this thesis it is useful to provide short working definitions of the main concepts that will be used. In addition many of the papers included in the present thesis involve neighbourhood effects on children and adolescents. Thus, next to the working definitions, an explanation why neighbourhood effects are so important for children and adolescents will be given.

Neighbourhood

The present thesis concentrates on neighbourhood-level context. Processes at the neighbourhood level are different from processes at further aggregated levels, like state or country level. For example, in the income inequality literature different effects have been reported at different levels of aggregation (Wilkinson, 1997) and we may expect analogous differences for other measures.

The MQoL studied neighbourhoods defined by local authorities. These authorities provided the official definitions of neighbourhoods throughout the Netherlands. Boundaries follow main roads and, therefore, are ecologically meaningful (CBS, 1996). These neighbourhood definitions are widely used by local authorities and researchers, and Statistics Netherlands (CBS) supplies a variety of characteristics on these neighbourhoods (CBS, 2003). The 36 Maastricht residential neighbourhoods have between 300 and 8500 residents.

Socioeconomic deprivation

Neighbourhood socioeconomic deprivation is a primary concept of the quality of neighbourhood social and structural environment. Neighbourhood socioeconomic deprivation is synonymous with neighbourhood socioeconomic disadvantage, neighbourhood poverty, and low neighbourhood socioeconomic status. It has been operationalised by an array of social indicators that characterize areas in which the so-called "underclass" lives (Wilson,

1987, Kasarda, 1993). The socioeconomic deprivation measure is usually composed of objective indicators, such as the proportion of unemployed, proportion receiving welfare, ethnic composition, and mean income.

Neighbourhood socioeconomic deprivation has been reported to affect individual's health over and above individual socioeconomic status, thus having deleterious effects for all inhabitants both poor or rich (Leventhal and Brooks Gunn, 2000, Dalgard and Tambs, 1997, Sloggett and Joshi, 1994, Diez Roux et al., 2001).

Social Capital

Previous studies have demonstrated that neighbourhood measures of "social capital" are associated with the health of both adults (Kawachi et al., 1999b) and children (Aneshensel and Sucoff, 1996). However, although, the term "social capital" has been widely used, there is no uniformity in definition. Some researchers defined social capital as an individual characteristic: family, friends, and acquaintances living close by or far away can supply all different kinds of resources to an individual (Portes, 1998, Walkup, 2003). However, most researchers defined social capital as a group characteristic and termed the individual equivalent "(personal) social networks" (McKenzie et al., 2002, McKenzie, 2003, Henderson and Whiteford, 2003). The present thesis follows this line of thought.

Kawachi et al have summarized the work of Putnam and Coleman and have "defined" social capital as "those features of social organisations – such as networks of secondary associations, high levels of interpersonal trust and norms of mutual aid and reciprocity – which act as resources for individuals and facilitate collective action" (Putnam, 1993, Coleman, 1990, Kawachi et al., 1999b, Bourdieu, 1986, Kawachi et al., 1997).

Social organisations can be persons living in one state, country, or neighbourhood, or persons visiting the same leisure club, and there can be many other definitions of groups, that are useful to apply when studying social capital. However, the impact of social capital may differ depending on the level of aggregation. For example, acquaintances on the other side of the city or the country can be helpful finding a job, but this is rather similar with the effect of individual-level personal social networks. On the other hand, norms, values, and behaviour of neighbours can impact on every day life. Therefore, as stated above, the present thesis specifically studies neighbourhood-level social capital. This also has been called institutional completeness (Tsukashima, 1985, Valdez, 1993).

In the Maastricht Quality of Life Study (MQoL) we adopted Kawachi's definition of social capital (Kawachi et al., 1999b). When this definition was simplified and concentrated on the neighbourhood-level, this lead to following definition: "The stock of social resources within a neighbourhood that residents need for social support and social control". In contrast to the objective socioeconomic measures at the neighbourhood level, the concept of neighbourhood social capital can only be measured by asking community members; they are the best informants of their neighbourhood.

Associations between neighbourhood characteristics

It has been proposed that the competition for scarce resources of residents of poor neighbourhoods generates mistrust (Ross et al., 2001), and this mistrust would lead to lower levels of cohesion between neighbours. Because both trust and cohesion are important dimensions of social capital, this would imply that socioeconomically deprived neighbourhoods are also low in social capital. In addition, researchers developed the "social disorganisation theory" suggesting that low levels of social capital in the neighbourhood are a direct consequence of a low socioeconomic status and socioeconomic deprivation (Markowitz et al., 2001, Kawachi et al., 1999a). Various researchers proposed that social

capital is a mediator on the pathway between socioeconomic deprivation and various health outcomes (McCulloch, 2003). Other research, however, demonstrated that a decline in community participation over two and a half decades, while there were no changes in socioeconomic status (Small, 2002). Therefore, before studying neighbourhood effects on quality of life and mental health outcomes, the associations between the neighbourhood factors must be studied.

Quality of Life

The most important outcome in the MQoL is health-related quality of life. The term quality of life has first been used shortly after the First World War (Ormel et al., 1997) and has been widely used since (Nussbaum, 1993). It has been studied in many different settings: chronically ill patients, (WHO, 1998, De Vries et al., 1998) mental health patients, (Elstner et al., 2001, Katschnig et al., 1997) and in the general population (WHO, 1998). It has been defined and conceptualised in many different ways (Landgraf et al., 1996, WHO, 1998, De Vries et al., 1998). General quality of life includes domains like income, freedom, and social support, while health-related quality of life is restricted to health outcomes (Katschnig et al., 1997).

Health-related quality of life, as a subjective measure of mental state, is to a large degree contingent on the level of psychiatric symptomatology (Orley et al., 1998, Schaar and Ojehagen, 2003, Berlim et al., 2003). Therefore, quality of life studies in the general population shed light on the part of mental health that drives variation in quality of life.

Treated Psychiatric Morbidity

Although the main outcome in the MQoL was Quality of Life, studying treated psychiatric morbidity can provide information on the more serious and treated mental health problems, as opposed to subjective outcomes of quality of life collected in the general population. Furthermore, objective measures of mental health may be affected differently than subjective measures of mental health. Therefore, the present thesis also reports on treated psychiatric morbidity.

Case Register data are designed to study effects on treated psychiatric morbidity. Because Case Registers longitudinally collect data on all psychiatric patients in a given region, including a limited set of individual-level demographic and socioeconomic characteristics, both the number of patients in a given period and the total care consumption of these patients are available for analyses. Therefore, the association between neighbourhood factors and the quantity of care consumption can be studied. In addition, by comparing the patient group with a control group associations between neighbourhood factors and the proportion of patients per neighbourhood can be studied. Previous research showed associations between neighbourhood socioeconomic deprivation and treated psychiatric morbidity (Driessen et al., 1998, Van Os et al., 2000), but social capital has never been studied using Case Register data.

The importance of neighbourhood effects in early adolescents

Adolescence is an age of increasing independence and autonomy, with more time being spent in neighbourhood settings, away from the family and the formal social control institution of the school (Allison et al., 1999). Adolescence is an age of rapid growing up into adulthood, involving more life events and changes than in adulthood, like going to secondary school. In addition, during adolescence there is an explosive increment of psychological and behavioural problems. Therefore, studying neighbourhood factors in adolescents can give more insight in the importance of the context. Previous studies mainly reported on neighbourhood effects in early childhood (i.e. 0-6 years of age) and late adolescence (16-19

years) (Leventhal and Brooks Gunn, 2000). The present thesis reports on early adolescents (11-15 years). When the present cohort will be followed longer, future studies can involve late adolescents.

Previous research and objectives of the present thesis

In the above paragraphs studies on associations between neighbourhood variables and various outcomes has been described. These studies are summarised in table 1. Table 1 shows that outcome measures, level of aggregation, and setting of the contextual studies were very diverse and the majority of social capital studies were performed in the U.S. In addition, sociologists gave a detailed description of social capital and its effect in one or a few communities (sociological studies). Only one large quantitative study (Chicago, US) was able to include neighbourhood-level measures of social capital (Buka et al., 2003, Sampson et al., 1997). Therefore, a series of analyses on neighbourhood-level social capital in one European setting using a broad spectrum of outcomes is warranted. Besides quality of life (subjective mental health) and treated psychiatric morbidity (objective mental health) the present thesis reports on an objective measure of physical health (growth) and school achievement.

More importantly, all but two (Dalgard and Tambs, 1997, Diez Roux et al., 2001) of the studies presented in table 1 were cross-sectional or data were aggregated to the macro level, while individual-level longitudinal studies are needed to learn more about causality and the course of the effects over time (Dalgard and Tambs, 1997). Therefore, the main data collection described in the present thesis is a cohort study including a baseline and a follow-up measurement (see below).

In sum, the present thesis studies associations between neighbourhood social capital and other neighbourhood measures, such as socioeconomic deprivation, on the one hand and quality of life and treated psychiatric morbidity on the other. In addition, analyses using follow-up data of a cohort study promises to provide stronger evidence for causality than in previous cross-sectional studies.

Methods of the MQoL

The university psychiatric department and the municipal health centre collaborated in the MQoL study, a longitudinal study of adolescents and their families in all Maastricht neighbourhoods (hereafter: family cohort study). The study aimed to follow up a cohort of early adolescents aged approximately 11 years at baseline into adulthood. In addition, both parents were also asked to fill in a questionnaire at baseline. The main outcome was quality of life. Both quality of life and individual level demographic and socioeconomic variables were included in the questionnaires for the children and the parents. The main independent variables were objective measures of neighbourhood socioeconomic deprivation, and neighbourhood-level subjective measures of social capital (see below). The neighbourhood measure of socioeconomic deprivation was based on factor analyses results of neighbourhood data obtained from the local authorities and Statistics Netherlands (CBS).

The methods of the MQoL were adapted from the Project on Human Development in Chicago Neighbourhoods (PHDCN) (Sampson et al., 1997). The neighbourhood variables and confounding factors that were studied were similar in both studies, but MQoL main outcomes were different. The main outcomes of the PHDCN were juvenile delinquency and violence, while the MQoL focussed on quality of life.

Table 1: Summary of previous research on area-level socioeconomic deprivation and social capital (alphabetical order)

	Measures	Study population	Study site	Conclusion	Remarks
A socioeconomic deprivation					
(Allison et al., 1999)	C[1]: Welfare receipt, childhood poverty O[2]: Stress	students from 2 local high schools, African-American	Capitol city neighbourhoods, eastern U.S.	Lower quality of the neighbourhoods resulted in a higher level of school stress	Low response rate
(Coulton et al., 1995)	C: impoverishment, child-care burden O: child maltreatment	general population	Cleveland urban census tracts, Ohio U.S.	Neighbourhood factors were associated with child maltreatment	Aggregate level analysis, thus individual factors not included
(Dalgard and Tambs, 1997)	C: quality of the neighbourhood O: Somatisation, anxiety, depression	> 19 years at baseline	1 Oslo neighbourhood, Norway	Both the quality of neighbourhood and residents mental health improved during the 10-year follow up period	10 year follow up study, but one neighbourhood only
(Diez Roux et al., 2001)	C: neighbourhood summary disadvantage score O: coronary heart disease	aged 45-64 years at baseline	neighbourhoods (=block groups) of 4 U.S. study sites	Persons living in disadvantaged neighbourhoods had more unfavourable risk factor profiles for CHD, but differences were small and disappeared after controlling for individual SES	10-year follow up
(Driessen et al., 1998)	C: socioeconomic deprivation; O: treated mental health	psychiatric patients	Maastricht neighbourhoods, The Netherlands	Higher rates of inpatient use might reflect more severe illness with poorer prognosis in deprived areas.	Limited set of individual characteristics

[1] C: Contextual measure
[2] O: Outcome measure

Table 1 continued: Summary of previous research on area-level socioeconomic deprivation and social capital (alphabetical order)

	Measures	Study population	Study site	Conclusion	Remarks
(Kalff et al., 2001)	C: socioeconomic deprivation; O: CBCL problem behaviour	children aged 5-7 years	Maastricht neighbourhoods, The Netherlands	Living in more deprived neighbourhood is associated with higher levels of child problem behaviour, irrespective of individual level socioeconomic status.	Multilevel analyses, controlling for appropriate set of individual factors
(Leventhal and Brooks Gunn, 2000)	C: socioeconomic deprivation O: various (behaviour, school achievement, etc)	children and adolescents of various ages	neighbourhoods of cities in various countries	Various associations between socioeconomic deprivation and outcomes	review
(Sloggett and Joshi, 1994)	C: deprivation O: premature mortality	population aged between 16 and 70 years	electoral wards in England and Wales	Positive association between deprivation and mortality, but association strongly attenuated when including individual factors	
(Van Os et al., 2000)	C: deprivation O: Schizophrenia	Psychiatric patients in the Maastricht population	Maastricht neighbourhoods, The Netherlands	Positive association between socioeconomic deprivation and schizophrenioa rates	Multilevel poisson analyses. No control for individual socioeconomic stat.

Table 1 continued: Summary of previous research on area-level socioeconomic deprivation and social capital (alphabetical order)

	Measures	Study population	Study site	Conclusion	Remarks
B Social capital (or social capital and socioeconomic deprivation)					
1 quantitative research					
(Aneshensel and Sucoff, 1996)	C: Social cohesion, ambient hazards; O: 4 measures of psychopathology	adolescents (12-17 year)	Los Angeles neighbourhoods, California U.S.	Research into mental health of young people needs to consider socioeconomic and demographic environment in which they live.	Social cohesion perceptions measured at the individual level
(Buka et al., 2003)	C: neighbourhood support; O: birth weight	White + African American mothers	Chicago neighbourhoods, Illinois U.S.	Results suggest a threshold effect of social support in Whites, because only effects in the top tertile, and no effects in African-Americans	Limitation: lack of individual-level data.
(Kawachi et al., 1997)	C: civic engagement., trust, social capital, poverty; O: mortality (various causes)	English speaking residents aged > 18 years	39 U.S. states	Association between social capital and mortality.	Ecological study, state level social capital and income inequality
(Kawachi et al., 1999a)	C: social disorganisation; O: crime	State level ecological data on violent crime	U.S. states	Strongest association between interpersonal trust and violent crime	idem
(McCulloch, 2001)	C: social capital, social disorganisation O: health	British Household panel Survey	British neighbourhoods	Lower social capital was associated with psychiatric morbidity and social disorganisation with health problems	Social capital perceptions measured at the individual level

Table 1 continued: Summary of previous research on area-level socioeconomic deprivation and social capital (alphabetical order)

	Measures	Study population	Study site	Conclusion	Remarks
(McKenzie et al., 2002)	C: Social capital; O: health and mental health	various	various	Higher levels of social capital may be beneficial to community members' health and mental health. However, probably not for members of groups within the community who do not live by the norms of the community.	Review
(Ross et al., 2001)	C: neighbourhood disorder and disadvantage; O: mistrust	English speaking residents aged > 18 year	Illinois census tracts, U.S.	Neighbourhood disadvantage and disorder were associated with mistrust, and disorder can be seen as a mediator	Multilevel
(Sampson et al., 1997)	C: collective efficacy; O: violence	children and adolescents of 7 overlapping age cohorts	Chicago neighbourhoods, Illinois U.S.	Collective efficacy mediated a substantial portion of the association of disadvantage with multiple measures of violence.	Multilevel. Collective efficacy obtained from a community survey
2 sociological research					
(Bruhn and Wolf, 1979)	C: Norms and values; O: Various diseases	Italian-American residents	Roseto = 1 community, U.S.	Rates of various diseases were low, because relationships were extremely close. However, with erosion of old norms and values, these rates increased	

Table 1 continued: Summary of previous research on area-level socioeconomic deprivation and social capital (alphabetical order)

	Measures	Study population	Study site	Conclusion	Remarks
(Small, 2002)	C: community participation	Predominantly Puorto-Ricans (1st and 2nd generation immigrants)	Villa Victoria = 1 neighbourhood in Boston, U.S.	Changes in structural conditions by themselves do not cause participation fall or rise in a neighbourhood, but these conditions do facilitate participation	
(Valdez, 1993)	C: Institutional completeness	Predominantly Mexican-Americans	3 low-income neighbourhoods of Laredo, Texas U.S.	The 3 Mexican-American neighbourhoods closely resemble underclass conditions. However, communities are more institutional complete.	

Perceived health, perceived mental health, a vitality scale and a mental health scale, (SF36 quality of life questionnaire (Ware and Gandek, 1998)), overall satisfaction (well being), and the WHO QoL BREF (WHO, 1998) have been defined as measures of health-related quality of life in adults. In addition, general health, mental health, self-esteem, and behaviour scales of the CHQ were included as measures of health-related quality of life in children and adolescents.

Because perceptions of social capital are always biased by individual quality of life status, it is difficult to disentangle cause and effect, when asking social capital and quality of life in the same group of respondents. Therefore, in order to avoid contamination by individual perceptions of the study population, social capital measures should be collected in a sample of informants independent of the study sample (Buka et al., 2003). For this reason, both MQoL and PHDCN included a community survey next to the family cohort study. The MQoL randomly selected approximately 200 inhabitants aged 20 to 65 years, from each of 36 Maastricht residential neighbourhoods, using the municipal database (community survey). These inhabitants received a questionnaire, which they were asked to fill in and send back. Social capital was measured using two collective efficacy scales: informal social control (ISC) and social cohesion and trust (SC&T), developed by Sampson and colleagues (Sampson et al., 1997, Sampson, 1997). Both scales were translated into Dutch and back translated into English. In order to adapt the ISC scale to the Dutch situation, five items corresponding to typical Dutch concerns were added. The ISC scale measures the willingness to intervene in hypothetical neighbourhood-threatening situations, for example in the case of children misbehaving or the opening of a brothel in the street. This scale is conceived in such a way that respondents are independent informants about their neighbours' willingness to intervene. The SC&T scale measures bonds and trust among the residents of the

neighbourhood. Both scales were aggregated to the neighbourhood level to serve as neighbourhood level measures when analysing the family cohort data. In addition, individual-level perceptions of social capital were studied. Community survey respondents were also enquired about various dimensions of quality of life, and individual level demographic and socioeconomic questions.

Furthermore, the present thesis makes use of a psychiatric case register, and the neighbourhood data were matched with the data of a case-control study on children's mental health service use.

Structure of the thesis

Chapter 2, 3, and 4 of the present thesis include various articles. The articles presented in chapter 2 report on adult data of the community survey and of the parents of the family cohort study (section 2.3). Before reporting on neighbourhood social capital itself (chapter 3), the articles in chapter 2 address socioeconomic deprivation and the related concepts residential instability and income inequality. All three articles describe analyses to place the concept of social capital in a wider perspective. This issue is further developed in the discussion chapter of the thesis (chapter 5).

Chapter 3 reports on associations between socioeconomic deprivation and social capital and various outcome variables in early adolescents. The first section presents results of the baseline measurement of the adolescents of the family cohort study and the second section makes an excursion to Chicago (Illinois, U.S.). Because some of our methods were adapted from the Chicago study (PHDCN) we were able to compare our measures of social capital, and the associations between the social capital measures and child-reported perceived health, between Maastricht and Chicago. The third and fourth articles report on an objective measure of child's health, growth, and school achievement respectively. The final article is based upon the follow-up measurement of the family cohort study, when the adolescents were aged 13 or 14 years.

Chapter 4 reports on mental health service use in adults and children respectively, as a measure of treated psychiatric morbidity. The final chapter 5 summarises all findings and discusses them in a broader perspective.

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Chapter 2

Adults

2.1 Mediators of neighbourhood socioeconomic deprivation and quality of life

Objective. We examined associations between neighbourhood socioeconomic deprivation and health-related quality of life, and estimated the mediating effects of individual-level lifestyle, housing, and perception of the neighbourhood environment.
Methods. Two different data-sources were used: 1) neighbourhood-level objective socioeconomic indicators, and 2) individual-level questionnaires from a community survey (response rate: 48%) to assess quality of life, neighbourhood perceptions, housing variables, and lifestyle. Multilevel analyses were conducted using both neighbourhood level and individual level data.
Results. Neighbourhood-level socioeconomic deprivation was associated with two aspects of individual-level quality of life: mental health and perceived health. Individual-level neighbourhood perceptions regarding social cohesion mediated these associations. Lifestyle also had mediating effects.
Conclusion. Neighbourhood socioeconomic deprivation variables may impact on the individual through cognitive mechanisms that are associated with appraisal of the wider social environment.

Key words. Quality of Life, Neighbourhood, Disadvantaged, Socioeconomic Status, Social Capital, Cognition

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ORIGINAL PAPER

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Mediators of neighbourhood socioeconomic deprivation and quality of life

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Abstract *Objective* We examined associations between neighbourhood socioeconomic deprivation and health-related quality of life, and estimated the mediating effects of individual-level lifestyle, housing, and perception of the neighbourhood environment. *Methods* Two different data sources were used: 1) neighbourhood-level objective socioeconomic indicators, and 2) individual-level questionnaires from a community survey (response rate: 48 %) to assess quality of life, neighbourhood perceptions, housing variables, and lifestyle. Multilevel analyses were conducted using both neighbourhood-level and individual-level data. *Results* Neighbourhood-level socioeconomic deprivation was associated with two aspects of individual-level quality of life: mental health and perceived health. Individual-level neighbourhood perceptions regarding social cohesion mediated these associations. Lifestyle also had mediating effects. *Conclusion* Neighbourhood socioeconomic deprivation variables may impact on the individual through cognitive mechanisms that are associated with appraisal of the wider social environment.

Key words quality of life – neighbourhood – disadvantaged – socioeconomic status – social capital – cognition

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Introduction

A shared social environment has been shown to influence both mental health [1–4] and somatic health [4–7] of individual persons, over and above individual differences. Neighbourhood measures that have been reported to contribute to the increased risk of poor general and mental health outcomes include neighbourhood socioeconomic deprivation [1, 6, 7], which can be conceptualised as socioeconomic status (SES) at neighbourhood level. This measure is usually composed of objective indicators, such as the proportion of unemployed, proportion receiving welfare, ethnic composition and mean income.

Presently, little is known about the possible mechanisms mediating associations between neighbourhood socioeconomic measures and individual health and mental health. It has been suggested that factors such as an unhealthy lifestyle [8, 9], unsatisfactory living environment [3, 10], stigmatised reputation of the area [11], poor quality of the housing [11], and lower levels of cohesion and informal social control [5, 12] are more prevalent in deprived areas, which may impact on individual health and mental health through collective mechanisms. However, little work has been carried out to directly test hypotheses on possible mediating factors. One study, actually investigating mediating and moderating effects, reported that parenting behaviour, peer characteristics and other characteristics of families or schools have been considered to be moderators or mediators of the association between neighbourhood socioeconomic deprivation and child and adolescent outcomes [12].

The present study investigated the association between neighbourhood socioeconomic status and health-related quality of life and the mechanisms involved. The term Quality of Life was coined shortly after the First World War [13] and has been widely used since [14]. Defined and conceptualised in many different ways [15–17], general quality of life includes domains like in-

come, freedom, and social support, while health-related quality of life is restricted to health outcomes [18]. Health-related quality of life, as a subjective measure of mental state, is to a large degree contingent on the level of psychiatric symptomatology [19–21]. Therefore, quality of life studies in the general population shed light on the part of mental health that drives variation in quality of life.

The aims of the current study were: (1) to study the associations between neighbourhood-level socioeconomic deprivation and quality of life, and (2) to examine to what degree any effects of neighbourhood socioeconomic deprivation on adult health-related quality of life were mediated by (a) lifestyle (i. e. smoking, dietary habits and exercising), (b) housing characteristics, and (c) perception of housing and the neighbourhood social and physical environment.

Subjects and methods

The Maastricht University Department of Psychiatry and Neuropsychology conducted a community survey in the neighbourhoods of Maastricht and obtained additional data on objective neighbourhood socioeconomic measures to estimate the effects of neighbourhood socioeconomic deprivation on health-related quality of life, over and above the effects of individual-level SES.

Maastricht is a relatively small city located in the extreme south of the Netherlands. Twenty per cent of the population have a non-Dutch nationality, but only 6% are of non-Western origin [22]. The Maastricht population consists of 122 000 inhabitants living in 36 residential neighbourhoods. The boundaries of these neighbourhoods follow main roads and are ecologically meaningful. Each of the 36 neighbourhoods houses between 300 and 8500 inhabitants (all ages). One of the 36 neighbourhoods was excluded because objective neighbourhood data were not available.

Health-related quality of life

Approximately 200 inhabitants aged 20–65 years were randomly selected, using the municipal database, from each of 36 Maastricht neighbourhoods (community survey). These inhabitants received a questionnaire including various dimensions of quality of life: the items of a vitality and a mental health subscale and a question on perceived health.

The vitality scale and the mental health scale are subscales of the SF36, a quality of life scale originally containing 36 questions that is based on the Medical Outcome Study [23]. Higher scores indicated higher vitality and mental health. Perceived health was addressed with one question: "How do you perceive your physical health, in general?" Respondents could choose their answers from a 5-item Likert type scale. The variable was recoded into a dichotomous variable (0 = excellent, very good, good; 1 = fair, poor), similar to previous studies [5, 24].

Neighbourhood socioeconomic deprivation

The city of Maastricht Municipal Statistics Department and CBS supplied objective neighbourhood data on various (socioeconomic) variables. In order to summarise these data into a lesser number of underlying constructs, a principal components factor analysis (without rotation) was carried out. The two identified factors, hereafter called "socioeconomic deprivation" and "residential instability", explained 70% of the total variance [4]. Percentage single-parent families, ethnicity, non-voters, unemployment, unemployment more than 1 year, social security, social security more than 3 years, mean income, mean income for persons employed 52 weeks a year, percentages high and low incomes, and percentage economically inactives loaded on socioeconomic deprivation. Single persons and various mobility variables loaded on residential instability. Factor scores were calculated for both the socioeconomic deprivation and residential instability, yielding continuous variables with mean 0 and unity standard deviation. Higher scores indicated more socioeconomic deprivation and more residential instability. Socioeconomic deprivation had a normal distribution; residential instability was somewhat skewed to the left.

Mediating factors

Lifestyle, housing characteristics, and perceptions of the neighbourhood and housing conditions were hypothesised to be mediating factors. Questions on the first set of mediators, lifestyle, were included in the community survey questionnaire: current smoking, drinking more than three alcoholic beverages a day, daily consumption of fruit, daily consumption of fresh vegetables, and daily bicycle use. Respondents could answer these questions with "yes" or "no". Furthermore, respondents were asked to fill in the average amount of time they spent on active sports per week and their height and weight, which we used to calculate the Body Mass Index (BMI = weight/height^2). The second set of mediators, objective housing conditions, was addressed using two indicators: the person-bedroom index (i. e. persons living in the house/bedrooms) and residential type (single room, apartment, town house, semi-detached, detached house). The third set, neighbourhood and housing perceptions, was addressed using questions about perceptions of neighbourhood maintenance, neighbourhood social contacts, neighbourhood *"cosiness"* (there is no English equivalent of the Dutch word *"gezelligheid"* that is used in the questionnaire. We chose the word *"cosiness"*, but it is also the combination of closeness, warmth and friendliness), neighbourhood safety, and housing conditions. Respondents were asked to give report marks on these items. In the Netherlands, these are answers on a 10-point Likert scale (1 = very bad, 10 = very good).

Statistical analysis

All analyses were performed using STATA (version 7) [25]. Data were grouped according to neighbourhood and were, in statistical terms, part of a multilevel structure with level-one units (individuals) structured into level-two units (neighbourhoods). These hierarchically structured data were subjected to multilevel regression analysis [26] in order to investigate neighbourhood effects while controlling for individual effects. Multilevel or hierarchical linear and logistic modelling techniques are a variant of unilevel linear and logistic regression analyses and are ideally suited for the analysis of clustered data, in this case consisting of multiple persons clustered within a single neighbourhood. The βs (linear) and the ORs (logistic) are the regression outcomes of the predictors in the multilevel model and can be interpreted identically to the estimates in the unilevel analyses. In the present paper, the βs were expressed in units SD of the outcome variables. According to Cohen [27], 0.8 standard deviations can be considered as a large effect size, and 0.2 standard deviations as a small effect size. Linear regression was done with maximum likelihood methods, logistic regression using generalised estimation equations.

All analyses testing for the associations between neighbourhood socioeconomic deprivation and quality of life were controlled for individual-level SES and welfare recipient status, because these are the individual-level equivalents of neighbourhood socioeconomic deprivation. The individual-level SES was estimated using occupational status (ISEI92) [28]. Because effect non-linearities were observed for this SES variable, the continuous variable was collapsed into five categories. Furthermore, models included household status (not single, single person, single-parent family), age group (20–34 years, 35–54 years, 55–65 years), and gender, and neighbourhood-level residential instability. SES, household status, and age group were entered as dummy variables in the equation, with the first category (low SES, not single, age 20–34 years) being the reference category. This resulted in the following fixed effects (random intercept) multilevel linear re-

gression model in which socioeconomic deprivation and residential instability were neighbourhood-level variables and all other variables were measured at the individual level:

$$\text{Quality of life} = \beta_0 + \beta_1\ \text{deprivation}_j + \beta_2\ \text{residential instability}_j + \beta_{3-6}\ \text{SES dummy}\ (1-4)_{ij} + \beta_7\ \text{welfare recipient}_{ij} + \beta_{8-9}\ \text{age group dummy}\ (1-2)_{ij} + \beta_{10}\ \text{gender}_{ij} + \beta_{11-12}\ \text{household status}_{ij} + \mu_j + \varepsilon_{ij}$$

in which μ_j is the error term at neighbourhood level and ε_{ij} is the error term at individual level. The quality of life variable was either vitality or mental health. In addition, a multilevel logistic regression model was used for the binary outcome perceived health, including the same variables.

One *a priori* interaction term between neighbourhood socioeconomic deprivation and individual-level SES was added to the models. In addition, three different sets of hypothesized mediating factors were added to all equations: 1) lifestyle factors: smoking, alcohol use, fruit, fresh vegetables, bicycle use, sports, and Body Mass Index; 2) objective housing characteristics: person-bedroom index, and type of residence; and 3) neighbourhood and housing perceptions: neighbourhood maintenance, neighbourhood social contacts, neighbourhood cosiness, neighbourhood safety, and housing conditions.

Results

Of the 7236 selected inhabitants, 48% responded (n = 3469). A total of 75 respondents were excluded: 69 respondents because they were living in the neighbourhood that was excluded in the present analyses and 6 because of missing values for neighbourhood (n = 3394). In all, 48% of the respondents were male, 34% were aged between 20 and 34 years, 46% were aged between 35 and 54 years and 20% were aged between 55 and 65 years. Thirty-two per cent of the respondents reported an occupation for which only elementary or lower level education was required. Women, persons aged between 55 and 65 years, and persons without a job (i. e. unemployed, housewife, etc.) were slightly overrepresented in the group of respondents, whereas singles (including students) were underrepresented, relative to the general population. The response rate varied between the neighbourhoods (32%–65%) and the rate was lower in neighbourhoods with higher socioeconomic deprivation scores (Pearson correlation: –0.67 $p < 0.001$).

Socioeconomic deprived neighbourhoods were spread across the periphery, and most of them were close to industrial areas (Fig. 1). Table 1 presents means, standard deviations and correlation coefficients of socioeconomic deprivation, all quality of life variables, and the hypothesised mediating factors.

Socioeconomic deprivation

Higher neighbourhood socioeconomic deprivation scores were associated with lower levels of mental health and, albeit statistically imprecise, with vitality (Table 2). Furthermore, higher socioeconomic deprivation was associated with poorer perceived health (Table 3).

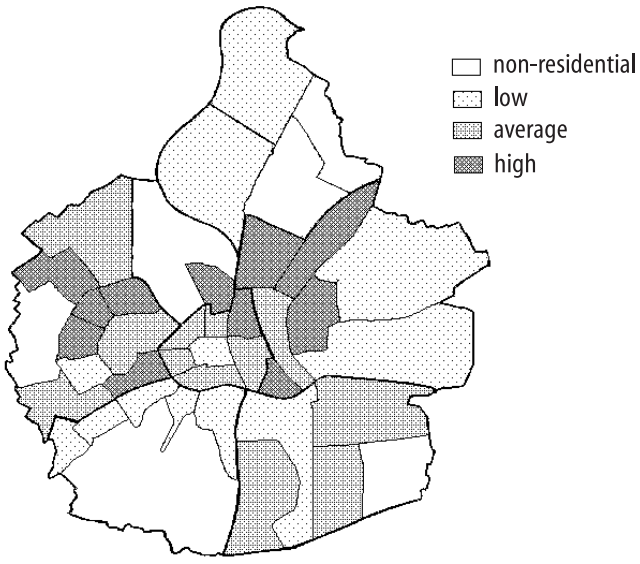

Fig. 1 Neighbourhood variation in socioeconomic deprivation

Mediating factors

Both dietary habit variables, both exercise variables and BMI were significantly associated with vitality; smoking, fruit consumption, and active sports were associated with mental health (Table 4). All these associations indicated that a healthier lifestyle was associated with higher levels of vitality and mental health. When including all lifestyle variables in the models, the β of the association between socioeconomic deprivation and mental health was similar to the β reported in Table 2 and remained statistically significant. However, the statistically imprecise association with vitality disappeared completely (Table 4). Smoking, both exercise variables and BMI were associated with perceived health (Table 5). When including the lifestyle variables in the models, the association between socioeconomic deprivation and perceived health disappeared. When including one lifestyle variable at a time in the perceived health and vitality models, BMI and smoking appeared to have the strongest mediating effects (data not shown).

When including the second set of mediating factors (objective housing characteristics) in the models, all associations between socioeconomic deprivation and outcome variables remained, although two of the three associations were statistically imprecise by conventional alpha (Tables 4 and 5).

Individual perceptions of neighbourhood social contacts and housing conditions were associated with vitality, mental health, and perceived health; and the perception of neighbourhood cosiness was associated with vitality (Tables 4 and 5). This third set had the strongest mediating effects. When including all perception variables in the models, the associations between socioeconomic deprivation on the one hand and vitality, mental health, and perceived health on the other disappeared (Tables 4 and 5).

Table 1 Means, standard deviations and Pearson correlation coefficients of socioeconomic deprivation, residential instability, all quality-of-life variables, and mediating factors

Neighbourhood factor		Descriptives N	Mean	Standard deviation	Range	Pearson correlations
Socioeconomic Deprivation	neighbourhoods	35	0.00	1.00	–1.69–1.68	
	individuals	3394	–0.07	0.97		

Quality of life	N	Mean	Standard deviation	Range	Vitality (SF36)	Mental health (SF36)
Perceived health	3353	3.16	0.85	1–5	0.48†	0.42†
Vitality (SF36)	3323	17.15	3.41	4–24		0.72†
Mental health (SF36)	3324	23.61	3.95	5–30		

Objective housing characteristics	N	Mean	Standard deviation	Range	Residential type
Person-bedroom index	3051	0.95	0.40	0.03–7.00	–0.07**
Residential type	3334	3.9	1.3	1–6	

Perceptions	N	Mean	Standard deviation	Range	Social contacts	Cosiness	Safety	Housing conditions
Perception of:								
neighbourhood maintenance	3324	6.9	1.7	0–10	0.31†	0.31†	0.41†	0.23†
neighbourhood social contacts	3286	6.5	1.9	0–10		0.70†	0.35†	0.22†
neighbourhood cosiness	3293	6.4	1.9	0–10			0.42†	0.22†
neighbourhood safety	3318	6.6	1.8	0–10				0.21†
housing conditions	3227	6.8	2.3	0–10				

† $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Table 2 Multilevel regression analysis; associations between socioeconomic deprivation and vitality and mental health (SF36)[1]

	Vitality (SF36) β (95% CI)	Mental health β (95% CI)
Socioeconomic deprivation (crude)	–0.11†,[2] (–0.16; –0.07)	–0.13† (–0.17; –0.09)
Final model		
Socioeconomic deprivation[3]	–0.04 (–0.09; 0.007)	–0.07** (–0.11; –0.02)
SES quintiles:		
low (reference category)	0	0
	0.19** (0.08; 0.30)	0.12* (0.01; 0.23)
	0.25† (0.14; 0.37)	0.28† (0.16; 0.39)
	0.32† (0.20; 0.44)	0.28† (0.16; 0.39)
high	0.36† (0.24; 0.48)	0.29† (0.17; 0.40)
welfare recipient	–0.35† (–0.47; –0.23)	–0.43† (–0.55; –0.31)

[1] Higher values of the outcome variables indicating better quality of life. Thus, βs below 0 indicate a negative influence on quality of life and βs above 0 a positive influence

[2] † $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

[3] Controlled for residential instability, occupational status, welfare recipient status, household status (not single, single person, single-parent family), age group (20–34 years, 35–54 years, 55–65 years) and gender

Table 3 Multilevel logistic regression analysis; associations between socioeconomic deprivation and perceived health[1]

	Perceived health OR (95% CI)
Socioeconomic deprivation (crude)	1.35†,[2] (1.20; 1.52)
Final model	
Socioeconomic deprivation[3]	1.14* (1.00; 1.30)
SES quintiles:	
low (reference category)	1.00
	0.60† (0.45; 0.80)
	0.54† (0.39; 0.74)
	0.50† (0.36; 0.71)
high	0.34† (0.24; 0.50)
welfare recipient	3.28† (2.48; 4.34)

[1] Poor or fair health compared with good, very good or excellent health. Thus, Odds Ratios above 1 indicate a negative influence on the outcome variables

[2] † $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

[3] Controlled for residential instability, occupational status, welfare recipient status, household status (not single, single person, single-parent family), age group (20–34 years, 35–54 years, 55–65 years) and gender

When including one perception variable at a time, neighbourhood cosiness and neighbourhood social contacts showed the strongest mediating effects on the associations between socioeconomic deprivation on the one hand and perceived health, vitality and mental health on the other (data not shown).

When including mediating variables, the associations between individual SES and all outcomes were also attenuated. However, when contrasting the two highest SES categories with the lowest, the associations remained highly significant (data not shown).

Table 4 Mediating factors in the associations between socioeconomic deprivation on the one hand and vitality and mental health on the other[1]

	Vitality (SF36) β (95% CI)	Mental health β (95% CI)
A) Model with mediating lifestyle variables[2]		
Socioeconomic deprivation	–0.02 (–0.07; 0.03)	–0.05* (–0.10; –0.01)
Smoking	–0.10 (–0.19; –0.02)	–0.12** (–0.20; –0.03)
Alcoholic beverages (> 3/day)	0.07 (–0.04; 0.18)	–0.01 (–0.10; 0.12)
Not daily fruit	–0.13**[3] (–0.21; –0.05)	–0.11** (–0.19; 0.03)
Not daily fresh vegetables	–0.13** (–0.22; –0.03)	–0.07 (–0.16; 0.02)
Not daily cycling	–0.09* (–0.16; –0.01)	0.00 (–0.07; 0.08)
Active sports (h/week)	0.02† (0.01; 0.03)	0.01* (0.00; 0.02)
BMI	–0.02† (–0.03; –0.01)	–0.01 (–0.02; 0.005)
B) Model with mediating housing characteristics[2]		
Socioeconomic deprivation	–0.03† (–0.08; 0.02)	–0.04 (–0.09; 0.00)
Person-bedroom index	–0.11* (–0.20; –0.01)	–0.10 (–0.19; 0.00)
Residential type	0.07** (0.03; 0.12)	0.08† (0.04; 0.13)
C) Model with mediating neighbourhood and housing perception[2]		
Socioeconomic deprivation	0.01 (–0.04; 0.06)	–0.01 (–0.05; 0.04)
Perception (10-point scale):		
neighbourhood maintenance	0.01 (–0.01; 0.04)	0.00 (–0.02; 0.03)
neighbourhood social contacts	0.04** (0.01; 0.07)	0.05† (0.02; 0.08)
neighbourhood cosiness	0.05** (0.02; 0.08)	0.03 (–0.00; 0.06)
neighbourhood safety	–0.00 (–0.03; 0.02)	0.01 (–0.01; 0.04)
housing conditions	0.04† (0.02; 0.06)	0.04† (0.02; 0.06)

[1] Higher values of the outcome variables indicating better quality of life. Thus, βs below 0 indicate a negative influence on quality of life and βs above 0 a positive influence

[2] This model also included all variables of the final model [residential instability, occupational status, welfare recipient status, household status (not single, single person, single parent family), age group (20–34 years, 35–54 years, 55–65 years) and gender]

[3] † $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Table 5 Mediating factors in the associations between socioeconomic deprivation and perceived health[1]

	Perceived health OR (95% CI)
A) Model with mediating lifestyle variables[2]	
Socioeconomic deprivation	1.05 (0.91; 1.21)
Smoking	1.86†,[3] (1.45; 2.38)
Alcoholic beverages (> 3/day)	0.92 (0.64; 1.34
Not daily fruit	1.23 (0.96; 1.59)
Not daily fresh vegetables	1.26 (0.96; 1.67)
Not daily cycling	1.69† (1.29; 2.21)
Active sports (hours/week)	0.93** (0.89; 0.98)
BMI	1.07† (1.04; 1.11)
B) Socioeconomic deprivation[2]	1.13 (0.99; 1.29)
Person-bedroom index	0.82 (0.59; 1.15)
Residential type	0.90 (0.79; 1.03)
C) Socioeconomic deprivation[2]	1.00 (0.87; 1.16)
Perception (10-point scale):	
neighbourhood maintenance	0.96 (0.89; 1.03)
neighbourhood social contacts	0.91* (0.84; 0.996)
neighbourhood cosiness	0.96 (0.88; 1.04)
neighbourhood safety	0.99 (0.92; 1.06)
perception housing conditions	0.91† (0.86; 0.95)

[1] Poor or fair health compared with good, very good or excellent health. Thus, Odds Ratios above 1 indicate a negative influence on the outcome variables

[2] This model also included all variables of the final model [residential instability occupational status, welfare recipient status, household status (not single, single person, single-parent family), age group (20–34 years, 35–54 years, 55–65 years) and gender]

[3] † $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Confounding variables

Individual SES and welfare recipient status were significantly associated with vitality and mental health (Table 2) and perceived health (Table 3). Males reported significantly better vitality, mental health and perceived health (data not shown). Furthermore, persons aged between 35 and 54 reported lower levels of mental health than younger persons and persons aged between 35 and 54 years or above 55 years reported higher rates of poor or fair perceived health. Respondents living in single-person households and single-parent families reported lower levels of vitality and mental health. None of the models showed interaction between neighbourhood socioeconomic deprivation and individual SES. Residential instability was not associated with any of the outcomes.

Discussion

Adjusted analyses showed that neighbourhood socioeconomic deprivation was associated with lower levels of perceived health and mental health, and albeit statistically inconclusive by conventional alpha, with vitality. These reported associations are in line with previous contextual studies in the general population, in which associations were reported between both individual socioeconomic status and neighbourhood socioeconomic deprivation on the one hand and premature mortality

[29], mental health service use [30], incidence of psychosis [2, 30], coronary heart disease in adults [6, 7], problem behaviour in children and adolescents [1, 31] and mental illness in children [10] on the other hand. Only some studies did not find an effect of neighbourhood socioeconomic deprivation, after controlling for individual-level SES [11, 32].

Both within and between neighbourhoods, differences in individual incomes and, consequently, differences in neighbourhood socioeconomic deprivation are much smaller in European cities, such as Maastricht, than, for example, in American cities, where much of the previous work was carried out. Policies in Europe have resulted in the constitution of a model European "caring state" which functions to prevent various forms of social exclusion through still relatively strong social safety in the Netherlands [33–35]. Our results, nevertheless, confirmed that even small differences in socioeconomic deprivation are associated with differences in quality of life outcomes.

Mediating mechanisms

In order to test the hypotheses on mediating mechanisms, we included three sets of mediating factors one after the other in all our multilevel models: lifestyle, objective housing characteristics, and perception of neighbourhood and housing conditions. Because the associations between socioeconomic deprivation and all outcome variables disappeared, we can conclude that the perception variables had the strongest mediating effects. Lifestyle variables also had mediating effects in the associations with physical health (vitality, perceived health), but not in the association with mental health. Objective housing variables did not have any mediating effects in our data.

Previous research hypothesised that collective group properties exert some influence over and above individual properties, so that the lifestyle of low SES residents is copied by higher SES residents living in low SES neighbourhoods [8, 36]. An example would be smoking behaviour in adolescents, which typically is subject to pressures from local peer groups. Secondly, living in an unpleasant, unsafe environment may induce making unhealthy lifestyle choices [8]. Furthermore, amenities in deprived neighbourhoods are adjusted to the socioeconomic status of the inhabitants, local commerce may provide cheaper, unhealthier foods, and there may be less opportunity for exercise. The present results gave evidence that one or more of these mechanisms are partly responsible for differences in vitality and perceived health between neighbourhoods.

However, perceptions of neighbourhood cosiness and neighbourhood social contacts particularly contributed to the associations between neighbourhood socioeconomic deprivation and health-related quality of life. Certain neighbourhood and housing conditions will per definition be worse and be perceived worse in poor neighbourhoods than in affluent neighbourhoods, but not cosiness and social contacts, which represent an entirely different construct than poverty [4]. Both cosiness and social contacts are aspects of social capital. Social capital can be defined as "those features of social organisations which act as resources for individuals and facilitate collective action" [37–39], and has been shown to be associated with various health and behavioural outcomes [4, 5, 40, 41]. The effects of neighbourhood cosiness and social contacts in deprived areas were already described decades ago in a group of Italian immigrants in Roseto, United States [42]. The Italian immigrants could only find economic opportunity to do manual work with insignificant salaries and, therefore, were forced to form a community in order to survive through supporting each other. This resulted in low rates of heart disease until the old community norms and values were no longer adhered to. More recent work identified poor neighbourhood and housing conditions as chronic stressors, which were shown to be mediators in the association between poverty and behavioural problems [43]. Furthermore, perception of neighbourhood disorder has been described to mediate the association between socioeconomic deprivation and individual-level mistrust [44].

Our data are in accordance with these findings, but in addition suggest that individual perceptions of neighbourhood social capital may play an important role in the relationship between neighbourhood socioeconomic deprivation and individual-level (mental) health. Thus, neighbourhood socioeconomic variables may impact on the individual through cognitive processes that are associated with appraisal of the social environment. This observation is relevant with regard to the ongoing discussion to what extent ecological effects, such as effects of the neighbourhood environment, are really the reflection of individual-level confounders [45]. The current findings lend credence to the suggestion that neighbourhood effects are truly contextual rather than individual [36].

Mediators vs. confounders

We postulated that lifestyle factors were mediators, but they can also be seen as individual-level confounders of a reported neighbourhood effect. Lifestyle can be seen both as a mediator and as a confounder. We postulated that lifestyle was a mediator rather than a confounder, because not only individual socioeconomic status but also neighbourhood socioeconomic deprivation can cause unhealthy lifestyles, as described above (mediating mechanisms).

Methodological issues

A major methodological concern of the present study was to obtain the neighbourhood socioeconomic depri-

vation variable independently of the respondents' answers on health outcomes. This was analytically critical because these variables describe whole neighbourhoods rather than the group of respondents. It is possible, however, that the measurement of individual neighbourhood perception variables was biased by individual mental health and outcome variables. For example, individuals feeling depressed might report less perceived neighbourhood cosiness because of their depression rather than because of the actual situation. However, there are four reasons to assume that the mediating effects of neighbourhood cosiness and neighbourhood social contacts are real rather than the result of measurement overlap. First, even when the individual neighbourhood perception variables were aggregated at neighbourhood level (i. e. were transformed into neighbourhood-level rather then individual-level variables), cosiness and social contacts showed mediating effects in the associations between socioeconomic deprivation and most quality-of-life variables, although not as strong as the individual-level variables. Second, neighbourhood perception variables of one half of the subjects, aggregated at the neighbourhood level, were correlated with the aggregated quality-of-life variables in the other half (Pearson correlations of social contacts and cosiness with all quality-of-life variables, and safety with four of the five quality-of-life variables between 0.35 and 0.60, $N = 36$, $p < 0.05$; maintenance was only associated with satisfaction). This suggests that associations between perception variables and quality of life were not spurious measurement artefacts caused by the same persons reporting on several variables. Third, only two of the four neighbourhood perception variables were associated with quality-of-life variables, while all four should have the same probability of reporting bias. Finally, the neighbourhood perception variables were associated with socioeconomic deprivation independently of mental health (i. e. after controlling for mental health in the analyses), indicating independent mediating effects.

Some previous contextual studies measured state or country level contextual effects [24, 46–50]. Other studies used smaller geographical units such as "local authority" areas [51], counties [52] or neighbourhoods [1–4, 6, 7, 41]. Contextual effects may be quite different when studying large or small geographical areas. However, most individuals perceive their neighbourhood as comprising their own street and perhaps one or two side streets (perceived neighbourhoods). The neighbourhoods defined in the present study are much larger and some are heterogeneous. When various heterogeneous perceived neighbourhoods are clustered, information about the shared environments of these perceived neighbourhoods is lost. Therefore, we repeated the analyses using homogeneous neighbourhoods only and the βs were similar or even stronger, and most of the statistical significance remained, even though the power of the analyses was much lower.

Residential instability was included as a confounder in all analyses, but was not associated with any of the outcomes. A recent study showed interaction effects between socioeconomic status and residential instability [53]. We will try to replicate these findings in future analyses.

The present study design has several limitations. First, the response rate of the community survey was only 48 %, and the rate was lower in more deprived neighbourhoods. Although the distribution of age, gender and ethnicity of the respondents did not differ much from that of all Maastricht inhabitants between 20 and 65 years of age, the low response rate in deprived neighbourhoods could reflect a general association between response rate and individual SES. If this were true, then respondents living in deprived neighbourhoods may be more similar, in terms of SES, to respondents living in non-deprived neighbourhoods than non-respondents living in deprived neighbourhoods. Consequently, the association between socioeconomic deprivation and health-related quality of life may even be stronger than our results suggested. Bias in the other direction could have occurred if non-responders in low SES neighbourhoods had a relatively good quality of life, whereas non-responders in high SES neighbourhoods had a relatively poor quality of life. However, this is unlikely.

Second, although the neighbourhood perception questions have been used before in local studies in the Netherlands [54], there is no information about the validity of the measures, as far as we know. However, the present study also included measures of social cohesion and trust [4, 41] and questions on chatting with or visiting neighbours. Perceptions of social contacts and cosiness were significantly correlated with these variables (Spearman correlations between 0.29 and 0.56, $p < 0.001$). Correlations of perceptions of social contacts and cosiness and answers on an informal social control scale [4, 41] were lower (0.13 and 0.14, respectively), but still highly significant ($p < 0.001$). Lower correlations were expected here, because questions whether the respondents thought that their neighbours would intervene in hypothetical situations are something different than social contacts and cosiness. Therefore, we feel that it is very likely that the perception variables are valid.

Furthermore, we included occupational status and all other individual-level variables that we hypothesised to possibly confound the associations with quality of life. Results were similar when we added educational status, which together with occupational status guarantees satisfactory control for individual-level SES in the Netherlands [55]. However, the possibility remains that residual confounding may have led to spurious results at the neighbourhood level, because of omitted variable biases [12]. To put it more simply, families moving into poor or not moving out of poor neighbourhoods may differ from their peers although equally poor or affluent (e. g. in motivation, literacy, etc). Random assignment is the best way to evenly divide these characteristics. Studying twins or siblings and following families over time are other methods to address omitted variable bias [12].

None of these methods were possible in the present study.

Finally, the intra-class correlations (ρ) in the models analysed with linear multilevel regression were low even in the empty models (intercept only; vitality: $\rho = 0.02$, satisfaction: $\rho = 0.03$). Thus, neighbourhood variance (σ_μ^2) was much lower than individual variance (σ^2). However, the neighbourhood variance was highly significant, indicating that neighbourhoods do matter. This supports the rationale for studying neighbourhood effects. In the final models of satisfaction and vitality, neighbourhood variance was much lower and the neighbourhood variance was only statistically significant in the vitality model (data not shown).

Implications

The increase of the level of appraised cosiness and social contacts may decrease the deleterious (mental) health effects of socioeconomic deprivation. If the findings of the present paper can be replicated, policy makers may be willing to put more effort into improving contacts with neighbours in poor neighbourhoods, in addition to interventions at the level of individual risk factors. This could be done, for example, by making it easier for neighbours to visit a community centre for activities.

Furthermore, people usually evaluate the neighbourhood before buying or renting a house, so that, theoretically, individuals with similar preferences and characteristics will concentrate in particular neighbourhoods. In other words, similar types of persons tend to cluster in the same neighbourhood (social selection). This means that neighbourhood effects are not related to the geography of the neighbourhood itself, but to the people actually living there. This, in combination with our finding of mediating effects of neighbourhood perceptions, suggests that the consequence is that interventions should focus on the interaction between the neighbourhood on the one hand and the people living there with their neighbourhood perceptions on the other. Advocating moving the people to another neighbourhood to solve quality-of-life problems will not be a solution from the point of view of our analysis.

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2.2 Residential instability in socioeconomically deprived neighbourhoods, good or bad?

Previously, both positive and negative effects of residential instability on various health outcomes have been described. The present study tests these effects in a European context, using two different data-sources 1) neighbourhood level data on socioeconomic deprivation and residential instability, and 2) individual-level community survey data to assess quality of life. Multilevel regression analyses showed that socioeconomic deprivation was negatively associated with several dimensions of quality of life, in stable neighbourhoods, while no such effect was observed in average or unstable neighbourhoods. Thus, when accounting for interaction effects, residential instability appeared to protect against negative effects of neighbourhood poverty and, therefore, may be beneficial for residents' quality of life.

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Residential instability in socioeconomically deprived neighbourhoods, good or bad?

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Abstract

Previously, both positive and negative effects of residential instability on various health outcomes have been described. The present study tests these effects in a European context, using two different data-sources (1) neighbourhood level data on socioeconomic deprivation and residential instability, and (2) individual-level community survey data to assess quality of life. Multilevel regression analyses showed that socioeconomic deprivation was negatively associated with several dimensions of quality of life, in stable neighbourhoods, while no such effect was observed in average or unstable neighbourhoods. Thus, when accounting for interaction effects, residential instability appeared to protect against negative effects of neighbourhood poverty and, therefore, may be beneficial for residents' quality of life.

Keywords: Residential instability; Disadvantage; Quality of life; Interaction effects

Introduction

Neighbourhood socioeconomic deprivation has been shown to influence both mental health (Leventhal and Brooks Gunn, 2000; Dalgard and Tambs, 1997; Sloggett and Joshi, 1994; Stafford and Marmot, 2003) and somatic health (Kawachi et al., 1999a; Diez Roux et al., 1997, 2001; Stafford and Marmot, 2003) of individual persons, over and above individual differences. Previous work has suggested that residential instability, a measure related to socioeconomic deprivation, is also associated with health-related outcomes (Shaw and McKay, 1969; Leventhal and Brooks Gunn, 2000; Coulton et al., 1995; Ennett et al., 1997). Residential instability measures residential turn-over, for example the relative number of neighbourhood residents who have moved in the last years or the proportion of households who have lived in their current home for less than 10 years (Ross et al., 2000; Leventhal and Brooks Gunn, 2000). Previously, higher levels of residential instability have been associated with child maltreatment (Coulton et al., 1995) life-time alcohol use in children (Ennett et al., 1997), juvenile delinquency (Shaw and McKay, 1969) and mental health in adolescents (Aneshensel and Sucoff, 1996). The neighbourhood social organisation theory has been proposed as accounting for the underlying mechanism. High rates of residential mobility have been associated with lower levels of social organisation in early American studies

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(Kasarda and Janowitz, 1974). This may result in the development of behavioural and health problems in children, suggesting also negative effects on individual health and well-being (Coulton et al., 1995; Kawachi et al., 1999b).

A recent American study, however, reported positive health effects of residential instability. Ross et al. (2000) hypothesised both negative and positive interaction effects to account for the conflicting theories in the literature. Interaction effects could occur when communities with a higher residential turnover are less cohesive as described in the social disorganisation theory. Socioeconomic deprivation would have a larger negative impact in these neighbourhoods. The results of the study by Ross and colleagues (Ross et al., 2000), however, showed the opposite: in stable neighbourhoods, socioeconomic deprivation was significantly and positively associated with psychological distress, whereas no such effect was found in unstable neighbourhoods. The authors invoked a social isolation perspective according to which neighbourhood socioeconomic deprivation in poor stable neighbourhoods may be more distressing. Stability in poor neighbourhoods is perceived by residents as tantamount to being trapped and powerless in a dangerous and frightening place.

Previous research in a relatively small European city (Maastricht) (Drukker et al., 2003) did not find evidence for an association between residential instability and either physical or mental health outcomes. However, interaction effects of residential instability were not taken into account. Inspired by the recent American findings, the present paper attempts to replicate the interaction between neighbourhood socioeconomic deprivation and residential instability, using outcome measures of health-related quality of life: perceived health, perceived mental health, vitality, mental health, and life satisfaction. These outcome measures are closely related to the construct of psychological distress used in the American study (Ross et al., 2000).

Methods

Research design

Maastricht is a relatively small Dutch city. Twenty per cent of the population has a non-Dutch nationality, but only 6% are of non-Western origin (CBS, 2003). The Maastricht population consists of 122,000 inhabitants living in 36 residential neighbourhoods, having between 300 and 8500 inhabitants (all ages). The boundaries of these neighbourhoods follow main roads and are ecologically meaningful. One of the 36 neighbourhoods was excluded in the analyses, because data on socioeconomic deprivation and residential instability were not available.

A community survey in the neighbourhoods of Maastricht was conducted and additional data on objective neighbourhood socioeconomic measures were obtained, to estimate effects of neighbourhood factors, over and above the effects of individual-level variables. Approximately 200 inhabitants from each of 36 neighbourhoods, aged 20–65 years, were randomly selected, using the municipal database (community survey). These inhabitants received a mailed questionnaire including questions on different dimensions of health-related quality of life.

Health-related quality of life

Perceived health, perceived mental health, the vitality scale and mental health scale of a quality of life questionnaire, and overall satisfaction (well being) were used as measures of health-related quality of life. Perceived health was addressed with one question: ''How do you perceive your physical health, in general?'' Respondents could choose their answers from a 5-item Likert-type scale. A similar question for perceived mental health was also included. Both variables were recoded into dichotomous variables (0 = excellent, very good, good; 1 = fair, poor), similar to previous studies (Kennedy et al., 1998; Kawachi et al., 1999a). The vitality and the mental health scales were derived from the SF36, which is based on the Medical Outcome Study (Ware and Gandek, 1998). Higher scores indicated higher vitality and better mental health. Life satisfaction was addressed by inquiring about the respondents' level of satisfaction with their overall life, number of friends, income, getting along with other people, leisure activities, family, friends, relatives, appearance, living conditions, money, religion, partner, job, and current education. Respondents once again chose their answers from a 5-item Likert-type scale (very satisfied, satisfied, moderate, unsatisfied, very unsatisfied). Factor analysis showed that all items except for religion, partner, job, and current education loaded on one underlying construct: overall satisfaction (Cronbachs' alpha 0.80). Some of the items were not applicable to all respondents. Furthermore, satisfaction with an item that a person does not consider important does not have as much influence on his or her quality of life as another item that a person considers very important. Therefore, the questionnaire also included a rating of subjective importance of all satisfaction items. A total sum score was constructed, whereby each satisfaction item was weighted by the subjective importance attached to it by the respondents. A recoding procedure resulted in scores between 1 (very unsatisfied) and 5 (very satisfied).

Neighbourhood socioeconomic deprivation and residential instability

The city of Maastricht Statistics Department and Statistics Netherlands (CBS) supplied all available objective neighbourhood data that can be used as estimators of socioeconomic characteristics. To summarise these data an exploratory factor analysis (principal factors without rotation) was carried out. The two identified factors, hereafter called "socioeconomic deprivation" and "residential instability", explained 70.0% of the total variance (Drukker et al., 2003). Percentage single parent families, ethnicity, non-voters, unemployment, unemployment more than 1 year, social security, social security more than 3 years, mean income, mean income for persons employed 52 weeks a year, percentages high and low incomes, and percentage economically inactives loaded on socioeconomic deprivation. Single persons and various mobility variables loaded on residential instability. Factor scores were calculated for both the socioeconomic deprivation and residential instability, yielding continuous variables with mean 0 and unity standard deviation. Higher scores indicated more socioeconomic deprivation and more residential instability.

Statistical analysis

All analyses were performed using STATA (version 7) (StataCorp., 2001). Data were grouped according to neighbourhood and were, in statistical terms, part of a multilevel structure with level-one units (individuals) structured into level-two units (neighbourhoods). These hierarchically structured data were subjected to multilevel regression analysis (Snijders and Bosker, 1999) in order to investigate neighbourhood effects while controlling for individual effects. Multilevel or hierarchical linear and logistic modelling techniques are a variant of the more often used unilevel linear and logistic regression analyses and are ideally suited for the analysis of clustered data, in this case consisting of multiple persons clustered within a single neighbourhood. The β_S (linear) and the odds ratios (OR) (logistic) are the regression outcomes of the predictors in the multilevel model and can be interpreted identically to the estimates in the unilevel analyses. In the present paper, the β_S were expressed in units SD of the outcome variables. According to Cohen (1988), 0.8 standard deviations can be considered as a large effect size, and 0.2 standard deviations as a small effect size. Linear regression was performed with maximum likelihood methods, logistic regression using generalised estimation equations (gee).

All analyses testing for the associations between neighbourhood variables and quality of life were controlled for individual-level occupational status (ISEI92) (Ganzeboom et al., 1992) educational status (in 7 categories) and welfare recipient status, because these are the individual-level equivalents of neighbourhood socioeconomic deprivation. Individual length of residence was included as the individual equivalent of residential instability. Because effect non-linearities were observed for occupational status, this continuous variable was collapsed into five categories. Furthermore, models included individual level household status (not single, single person, single parent family), age group (20–34 years, 35–54 years, 55–65 years) and gender. Occupational status, educational status, household status, and age group were entered as dummy variables in the equation, with the first category (low occupational status, elementary educational status, not single, age 20–34 years) being the reference category. This resulted in the following fixed effects multilevel linear regression model in which socioeconomic deprivation and residential instability were neighbourhood level variables and all other variables were measured at the individual level:

$$\begin{aligned}\text{Outcome} = {} & \beta_0 + \beta_1\ \text{socioeconomic deprivation}_j \\ & + \beta_2\ \text{residential instability}_j \\ & + \beta_{3-6}\ \text{occupational status dummy}\,(1-4)_{ij} \\ & + \beta_{7-12}\ \text{educational status dummy}\,(1-6)_{ij} \\ & + \beta_{13}\ \text{family welfare recipient}_{ij} \\ & + \beta_{14-15}\ \text{age group dummy}(1-2)_{ij} \\ & + \beta_{16}\ \text{gender}_{ij} \\ & + \beta_{17-18}\ \text{household status}_{ij} \\ & + \beta_{19}\ \text{length of residence}_{ij} + \mu_j + \varepsilon_{ij}.\end{aligned}$$

The outcome variables were vitality, mental health or life satisfaction, and the multiple error terms reflect residual variation at each level: individual (ε_{ij}) and neighbourhood (μ_j). In addition, one a priori interaction term between neighbourhood socioeconomic deprivation and residential instability was added to all models.

Furthermore, multilevel logistic regression models including the same variables were used for the binary outcomes perceived health and perceived mental health. Again the models were run with and without the interaction term.

Results

Response

Forty-eight per cent of the selected sample responded ($n = 3469$). Forty-eight per cent of the respondents were male, 46% of the respondents were aged between 35 and 54 years, and 34% were aged below 35. Thirty-two per cent of the respondents reported an occupation for which only elementary or lower level education was required. Women, persons aged between 55 and 65

years, and persons without a job (i.e. unemployed, housewife, etc.) were slightly over-represented in the group of respondents, whereas singles (including students) were underrepresented, relative to the general population. The response rate varied between the neighbourhoods (32–65%) and the rate was lower in neighbourhoods with higher socioeconomic deprivation scores (Pearson correlation: -0.67, $p<0.001$, $n=35$).

Socioeconomic deprivation was not concentrated in the centre, whereas residential instability was (not shown). Table 1 presents means, standard deviations and correlation coefficients of socioeconomic deprivation, residential instability, and the quality of life variables.

Individual level factors

Occupational status and educational status were significantly but non-linearly associated with vitality, mental health (Table 2) and perceived health (Table 3). Life satisfaction was associated with occupational status, perceived mental health with educational status. All five outcome variables were associated with welfare recipient status. Furthermore, males reported significantly better vitality, mental health, and perceived health, whereas females reported significantly better life satisfaction. Persons aged between 35 and 54 years reported lower levels of life satisfaction and persons aged above 55 years reported lower levels of perceived health than younger persons. Respondents living in single person households and single parent families reported lower levels of vitality, mental health, life satisfaction, and perceived mental health. Persons living longer in the same dwelling (length of residence) reported higher levels of vitality.

Residential instability and socioeconomic deprivation

Multilevel analyses showed that the interaction term of socioeconomic deprivation by residential instability was statistically significant in vitality (Table 2) and perceived health (Table 3). This interaction term was also apparent in mental health, albeit statistically imprecise by conventional alpha. To further clarify the dynamics of the interaction effect we calculated βs of socioeconomic deprivation for unstable neighbourhoods (i.e. original variable-1SD), average neighbourhoods (β in tables), stable neighbourhoods (i.e. original variable + 1SD), and very stable neighbourhoods (i.e. original variable + 2SD), using the models described in Tables 2 and 3. In stable neighbourhoods, socioeconomic deprivation was significantly associated with lower levels of both vitality ($\beta=-0.11$) and mental health ($\beta=-0.11$). In very stable neighbourhoods the associations were even stronger (-0.23 and -0.21, respectively; Table 4). In addition, in stable and very stable neighbourhoods

Table 1
Means, standard deviations and Pearson correlation coefficients of socioeconomic deprivation, residential instability, and all quality of life variables

		Descriptives				Pearson correlations				
		N	Mean	Standard deviation	Range	Residential instability				
Socioeconomic Deprivation	Neighbourhoods	35	0.00	1.00	−1.69–1.68	−0.00				
	Individuals	3394	−0.07	0.97						
Residential Instability	Neighbourhoods	35	0.00	1.00	−1.12–4.17					
	Individuals	3394	−0.08	0.81						
		N	Mean	Standard deviation	Range	Mental health (SF36)	Life satisfaction	Perceived health	Perceived mental health	
Vitality (SF36)		3323	17.15	3.41	4–24	0.72†	0.45†	0.48†	0.49†	
Mental health (SF36)		3326	23.61	3.95	5–30	1	0.51†	0.42†	0.54†	
Life satisfaction		3333	3.88	0.46	1.4–5.0		1	0.37†	0.41†	
Perceived health		3353	3.16	0.85	1–5			1	0.58†	
Perceived mental health		3343	3.43	0.86	1–5				1	

† $p<0.001$.

Table 2
Socioeconomic deprivation and residential instability, multilevel linear regression coefficients and 95% confidence intervals (CI)

	Vitality (sf36) β (95% CI)	Mental health (sf36) β (95% CI)	Life satisfaction β (95% CI)
Socioeconomic deprivation	0.01 (−0.05; 0.07)	−0.02 (−0.08; 0.03)	−0.08** (−0.13; −0.03)
Residential instability	0.05 (−0.02; 0.11)	0.009 (−0.05; 0.07)	0.03 (−0.03; 0.08)
Interaction			
Deprivation × instability	0.12*	0.09	0.04
Occupational status			
Low (reference)	0	0	0
	0.10 (−0.008; 0.22)	0.04 (−0.07; 0.15)	0.18** (0.07; 0.30)
	0.14* (0.02; 0.27)	0.16* (0.03; 0.28)	0.20** (0.08; 0.32)
	0.16* (0.03; 0.30)	0.11 (−0.03; 0.24)	0.30† (0.16; 0.43)
High	0.15* (0.01; 0.30)	0.08 (−0.06; 0.22)	0.31† (0.16; 0.45)
Educational status			
Elementary (reference)	0	0	0
Lower secondary	0.26† (0.12; 0.40)	0.18* (0.04; 0.32)	0.15* (0.01; 0.29)
Intermediate vocational	0.28† (0.15; 0.41)	0.27† (0.14; 0.40)	0.11 (−0.02; 0.24)
Higher secondary	0.34† (0.20; 0.48)	0.31† (0.17; 0.45)	0.05 (−0.09; 0.19)
Higher vocational	0.33† (0.19; 0.47)	0.35† (0.21; 0.48)	0.12 (−0.02; 0.26)
University	0.43† (0.26; 0.60)	0.36† (0.19; 0.52)	0.18* (0.01; 0.35)
Other	0.11 (−0.06; 0.27)	0.10 (−0.06; 0.26)	−0.06 (−0.23; 0.10)
Welfare recipient status			
Yes	−0.35† (−0.47; 0.23)	−0.43† (−0.55; -0.31)	−0.36† (−0.46; -0.22)
Age			
18–24 years (reference)	0	0	0
35–54 years	−0.04 (−0.13; 0.05)	−0.08 (−0.17; 0.002)	−0.11* (−0.20; −0.02)
55–70 years	0.06 (−0.06; 0.19)	−0.008 (−0.13; 0.12)	−0.04 (−0.16; 0.08)
Gender			
Men	0.16† (0.09; 0.23)	0.18† (0.11; 0.25)	−0.17†(−0.24; -0.09)
Household status			
Partner (reference)	0	0	0
Single	−0.13* (−0.23; −0.03)	−0.26† (−0.36; −0.16)	−0.36† (−0.46; −0.26)
Single parent	−0.38** (−0.60; −0.16)	−0.41† (−0.63; −0.19)	−0.44† (−0.66; −0.22)
Length of residence (year)	0.005* (0.001; 0.009)	0.001 (−0.003; 0.005)	0.004 (−0.0002; 0.008)
Intra class correlation (ρ)	0.0075	0.0034	0

*$p<0.05$, **$p<0.01$, †$p<0.001$.

residents more often reported low perceived health (OR = 1.36 and 1.88, respectively). Inversely, the results did not show any association in average or unstable neighbourhoods.

Discussion

Our study, similar to the study of Ross et al. (2000), suggests that residential instability may be beneficial in deprived neighbourhoods. The effects of socioeconomic deprivation were most salient in neighbourhoods with low residential turnover, suggesting that the social isolation theory has relevance in Europe as it does in America (Ross et al., 2000). Both the current European and the previous US study suggest that there are no associations between neighbourhood poverty and well-being in residentially unstable neighbourhoods. One aggregated level study also reported interaction effects: instability was associated with higher levels of maltreatment, but effects were smaller in poor neighbourhoods (Coulton et al., 1995). In order to compare these findings with our findings, we recalculated the effect of neighbourhood poverty in stable and unstable neighbourhoods, using their tables. Again, the effect of poverty seemed to be smaller in more unstable neighbourhoods,

Table 3
Socioeconomic deprivation and residential instability, multilevel logistic regression odds ratios (OR) and 95% confidence intervals (CI)

	Low perceived health OR (95% CI)	Low perceived mental health OR (95% CI)
Socioeconomic deprivation	0.98 (0.83; 1.16)	1.10 (0.90; 1.34)
Residential instability	0.94 (0.78; 1.14)	0.95 (0.76; 1.17)
Interaction	0.72*	0.92
Deprivation × instability		
Occupational status		
Low (reference)	1.00	1.00
	0.67** (0.49; 0.90)	0.97 (0.65; 1.45)
	0.65* (0.46; 0.92)	0.73 (0.45; 1.18)
	0.71 (0.48; 1.04)	0.68 (0.38; 1.20)
High	0.57* (0.36; 0.90)	1.25 (0.69; 2.27)
Educational status		
Elementary (reference)	1.00	1.00
Lower secondary	0.70 (0.47; 1.04)	0.80 (0.48; 1.34)
Intermediate vocational	0.72 (0.50; 1.04)	0.78 (0.47; 1.27)
Higher secondary	0.48** (0.31; 0.74)	0.54* (0.31; 0.95)
Higher vocational	0.53** (0.35; 0.80)	0.38** (0.21; 0.70)
University	0.35† (0.20; 0.62)	0.28** (0.12; 0.61)
Other	0.90 (0.59; 1.38)	0.81 (0.45; 1.46)
Welfare recipient status		
Yes	3.42† (2.56; 4.58)	2.84† (1.96; 4.11)
Age		
18–24 years (reference)	1.00	1.00
35–54 years	1.17 (0.89; 1.56)	1.09 (0.76; 1.59)
55–70 years	1.44* (1.00; 2.07)	0.94 (0.56; 1.55)
Gender		
Men	0.71** (0.57; 0.89)	0.83 (0.62; 1.13)
Household status		
Partner (reference)	1.00	1.00
Single	1.27 (0.95; 1.71)	1.53* (1.04; 2.24)
Single parent	1.26 (0.69; 2.30)	2.02* (1.02; 3.99)
Length of residence	1.00 (0.99; 1.01)	1.00 (0.99; 1.02)

*$p<0.05$, **$p<0.01$, †$p<0.001$.

but two secondary outcomes (violent crime, teen childbearing) showed larger effects of poverty in unstable neighbourhoods (Coulton et al., 1995).

Previous studies not including interaction effects reported no effects or negative effects of residential instability. Two aggregated level studies reported that residential instability was associated with an increase of life-time alcohol use (but not with life-time cigarette or marihuana use) in children and juvenile delinquency in adolescents (Ennett et al., 1997; Shaw and McKay, 1969). Previous multilevel studies (Coulton et al., 1999; Drukker et al., 2003) did not find any effect of residential instability. Future research in Europe as well as America should be aware of the fact that ignoring the interaction between neighbourhood poverty and residential instability may result in finding no or even negative effects of residential instability, when, in fact, effects actually may be positive in more complete models.

Ross et al. suggested that the interaction results indicated that residents of stable poor neighbourhoods feel trapped and powerless in a hopeless situation (Ross et al., 2000). Although previous Maastricht research reported effects of socioeconomic deprivation (Drukker et al., 2003), we did not expect residents of the poorer neighbourhoods to feel trapped in that environment, because differences in individual incomes and socioeconomic status are much smaller in the Netherlands than in American cities. This is due to differences in culture as well as the European public health and

Table 4
The dynamics of the interaction: associations between socioeconomic deprivation and vitality and mental health (β) and between socioeconomic deprivation and perceived health (OR) for unstable neighbourhoods, average neighbourhoods, stable neighbourhoods, and very stable neighbourhoods

Neighbourhood stability ↓		Vitality β (95% CI)	Mental health β (95% CI)	Low perceived health OR (95% CI)
Unstable	Socioeconomic deprivation	0.14 (−0.02; 0.30)	0.07 (−0.07; 0.21)	0.71 (0.46; 1.10)
Average	Socioeconomic deprivation	0.01 (−0.05; 0.07)	−0.02 (−0.08; 0.03)	0.98 (0.83; 1.16)
Stable	Socioeconomic deprivation	−0.11* (−0.20; −0.02)	−0.11** (−0.20; −0.03)	1.36* (1.06; 1.74)
Very stable	Socioeconomic deprivation	−0.23* (−0.43; −0.04)	−0.21* (−0.38; −0.03)	1.88* (1.09; 3.22)

*$p<0.05$, **$p<0.01$, †$p<0.001$.

welfare policy of a "caring state" (Kleinhans et al., 2001; Thompson, 2000; De Swaan, 1988). On the contrary, we expected negative effects of residential instability, in line with the social disorganisation theory. Neighbourhoods with low residential turnover were reported to have higher levels of social cohesion (social capital) (Aneshensel and Sucoff, 1996), which has been reported to be associated with higher levels of mental health and quality of life in Maastricht (Drukker et al., 2003). However, in finding that the interaction effect of residential instability in Maastricht is similar to the interaction effect found in the US (Ross et al., 2000), we conclude that more attention needs to be paid to social isolation theories in future European studies despite the apparent differences in culture and policy.

Another explanation for the effect of socioeconomic deprivation in stable neighbourhoods only, could be that the impact of the neighbourhood is larger when residents are longer exposed to the social environment. In addition, residents of unstable neighbourhoods may be students and other young and healthy temporary residents. However, results were controlled for individual length of residence and there were no interaction effects between length of residence and socioeconomic deprivation. Another explanation could be that some poor neighbourhoods were instable because of urban renewal projects. The quality of the houses and the environment may be better despite the poverty of these 'new' neighbourhoods, resulting in a better quality of life. However, none of the Maastricht neighbourhoods were subjected to urban renewal projects before or during the data collection.

Methodological issues

A major methodological concern of the present study was to obtain the neighbourhood socioeconomic deprivation and residential instability variables independently of the respondents' answers on health outcomes. This was analytically critical because these variables describe whole neighbourhoods rather than the group of respondents.

The present study design has several limitations. First, the response rate of the community survey was only 48%, and the rate was lower in more deprived neighbourhoods. This response rate was considerably lower than reported in the Ross et al. study where resources allowed for a much more intensive call back procedure. Although the distribution of age, gender and ethnicity of the respondents did not differ much from that of all Maastricht inhabitants between 20 and 65 years of age, the low response rate in deprived neighbourhoods could reflect a general association between response rate and individual SES. If this were true, than respondents living in deprived

neighbourhoods may be more similar, in terms of SES, to respondents living in non-deprived neighbourhoods than non-respondents living in deprived neighbourhoods. Consequently, the association between socioeconomic deprivation and health-related quality of life may even be stronger than our results suggested. Bias in the other direction could have occurred if non-responders in low SES neighbourhoods had a relatively good quality of life, whereas non-responders in high SES neighbourhoods had a relatively poor quality of life. However, this is unlikely. In addition, it could be difficult to reach respondents by mail in highly unstable neighbourhoods. However, up-to-date addresses were obtained from the Maastricht local authorities (all Dutch local authorities have up-to-date addresses because of compulsory registration) and the Maastricht neighbourhoods are sufficiently stable to guarantee that the majority of the respondents of instable neighbourhoods were reached, using these up-to-date addresses. In addition, residential instability and response rate were only moderately associated (Pearson correlation -0.23, $n = 35$).

Second, we included occupational status, educational status and all other individual-level variables that we hypothesised to possibly confound the associations with quality of life. Including educational status and occupational status guarantees satisfactory control for individual level SES in the Netherlands (Van Berkel-Van Schaik and Tax, 1990). However, the possibility remains that residual confounding may have lead to spurious results at the neighbourhood level, because of omitted variable biases (Leventhal and Brooks Gunn, 2000). To put it more simply, families moving into poor or not moving out of poor neighbourhoods may differ from their peers although equally poor or affluent (e.g. in motivation, literacy, etc.). One way to address this issue is random assignment of volunteering families living in poor neighbourhoods to move into affluent neighbourhoods, into other poor neighbourhoods, or not to move at all (Leventhal and Brooks Gunn, 2000). This has been done in 'moving to opportunity' (MTO) projects. The results showed that overall health, safety, boy's problem behaviour and well being improved in the families that moved to affluent areas (Sampson et al., 2002). This gives further support to the validity of the cross-sectional results in the present paper.

Finally, the intra class correlations (ρ) were low in even the empty multilevel statistical models (intercept only). However, the neighbourhood variance (σ^2_μ) was statistically significant for most of the linear regression outcome variables, indicating that neighbourhoods do matter. This further supports the accumulating evidence for studying neighbourhood effects in all public health outcome variables. Unfortunately, the STATA gee procedure does not provide information on random effects.

Implications

The results of the present study do not indicate why the effect of socioeconomic deprivation is larger in neighbourhoods with a low residential turnover. Most likely, promoting frequent moving of residents living in poor neighbourhoods is no solution of the problem. Probably helping residents in (stable) poor neighbourhoods to find job opportunities could help. In the poorest Maastricht neighbourhood, policy makers have started a project to give residents the opportunity to work at an adjacent industrial estate. In the near future, follow-up measurements of the cohort study in young adolescents, which has been launched together with the data collection presented in the present paper (Drukker et al., 2003), can evaluate the effect of this intervention in improving public health and decreasing the sense of powerlessness in deprived neighbourhoods.

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2.3 Income inequality at neighbourhood level and health-related quality of life, a contextual analysis

Objective Associations were examined between neighbourhood income inequality and neighbourhood socioeconomic deprivation on the one hand and (mental) health related quality of life on the other, in Maastricht, the Netherlands.
Methods Three different data-sources were used: 1) neighbourhood socioeconomic indicators, 2) house prices per postal code area aggregated to an inequality measure at neighbourhood level, and 3) individual data measured in a family cohort study. Maastricht families with children aged approximately 11 years received questionnaires including the parents' quality of life and family socioeconomic status (response rate: 60%). Multilevel analyses were conducted using neighbourhood level, family level, and individual level data.
Results Income inequality at neighbourhood level was not associated with any of the quality of life measures, whereas socioeconomic deprivation was associated with environment-related quality of life.
Conclusion The relative income hypothesis, according to which it is the contrast in deprivation rather than the absolute level of deprivation that influences health outcomes, does not hold at the neighbourhood level. Income inequality may only have an effect in larger areas containing sufficient socioeconomic contrast.

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ORIGINAL PAPER

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Income inequality at neighbourhood level and quality of life

A contextual analysis

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Abstract *Objective* Associations were examined between neighbourhood income inequality and neighbourhood socioeconomic deprivation on the one hand and (mental) health related quality of life (QoL) on the other, in Maastricht, the Netherlands. *Methods* Three different data sources were used: 1) neighbourhood socioeconomic indicators, 2) house prices per postal code area aggregated to an inequality measure at neighbourhood level, and 3) individual data measured in a family cohort study. Maastricht families with children aged approximately 11 years received questionnaires including the parents' QoL and family socioeconomic status (response rate: 60 %). Multilevel analyses were conducted using neighbourhood level, family level, and individual level data. *Results* Income inequality at neighbourhood level was not associated with QoL, whereas socioeconomic deprivation was associated with environment-related QoL. *Conclusion* The relative income hypothesis, according to which it is the contrast in deprivation rather than the absolute level of deprivation that influences health outcomes, does not hold at the neighbourhood level. Income inequality may only have an effect in larger areas containing sufficient socioeconomic contrast.

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Key words quality of life – neighbourhood – disadvantaged – socioeconomic status – inequality

Introduction

Low neighbourhood socioeconomic status (or socioeconomic deprivation) has been reported to contribute to an increase in risk of general and mental health problems [1–4]. More recently, however, income differences within areas are increasing because the rich are getting richer and the poor poorer [5]. It has been argued that it may not be absolute levels of objective socioeconomic deprivation that contribute to health problems (the absolute income hypothesis), but rather that the causal factor is income inequality within a geographical unit, suggesting that everyone, poor or rich, would benefit from a more equal income distribution (the relative income hypothesis) [5]. Multilevel analysis is best suited to disentangle the effects of individual inequalities and the shared disadvantage of living in an income-unequal neighbourhood. However, only some previous studies were able to include both individual-level and area-level data needed to conduct multilevel analyses [6–10].

Several pathways have been proposed to underlie the relative income hypothesis. First, the subjective sense of relative deprivation may be damaging to health [5]. In that case, for example, middle-income residents of an affluent area would be worse off than middle-income residents of a middle-income area. Second, inhabitants living in areas with high levels of income inequality may belong to different social groups, creating social contrasts that may be difficult to bridge. The resulting lower levels of social capital (e. g. social bonds) have been reported to be associated with poor somatic and mental health [11].

Most of the multilevel studies [6–9] were restricted to mortality or mortality-related outcomes, which presumably measure physical health. Only one multilevel study used perceived health as an outcome [10]. Thus, although the above-mentioned pathways suggest an asso-

ciation between income inequality and mental health, studies using mental health or related outcomes are scarce. Health-related quality of life (QoL), as a subjective measure of mental state, is to a large degree contingent on the level of psychiatric symptomatology [12–14]. Therefore, QoL studies in the general population shed light on the part of mental health that drives variation in QoL.

Furthermore, income inequality has mostly been studied at state or country level [6–8, 15, 16] and only a few studies used smaller geographical units, i. e. wards [17], (combined) county areas [9], or parishes [18]. Recently, population size has been identified as a factor that modifies the strength of the associations between income inequality on the one hand and mortality and perceived health on the other [10, 19], and Wilkinson argued that the population needs to be large enough to contain salient social stratification [20]. In addition, inequality at state or country level is something different from inequality within smaller geographical areas, such as neighbourhoods. For example, economic segregation is linked both with income inequality at state level, and with equality at neighbourhood level: it occurs when homogeneous neighbourhoods differ greatly from one another [10]. Studies on income inequality in smaller areas, such as neighbourhoods, may be used to further explore the relative income hypothesis.

In addition, due to differences in culture as well as the European public health and welfare policy of a "caring state" [21, 22], western European societies are not segregated and some poor people actually live in affluent neighbourhoods. Consequently, differences in income within neighbourhoods are larger. Therefore, small areas such as neighbourhoods in a country like the Netherlands, containing several thousand inhabitants, may be large enough to yield significant social stratification.

The present paper, therefore, explores the relative income hypothesis, focusing on variation in QoL, including variation in mental health, in the neighbourhoods of a relatively small western European city. Associations between neighbourhood-level income inequality and socioeconomic deprivation on the one hand and individual-level QoL in adults on the other were analysed. In addition, the sense of relative deprivation was addressed by studying the interaction between individual-level socioeconomic status and neighbourhood socioeconomic deprivation.

Subjects and methods

Research design

The Maastricht University Department of Psychiatry and Neuropsychology and the Youth Health Care Division of the Municipal Health Centre launched a longitudinal cohort study of children and their parents in Maastricht neighbourhoods (hereafter: family cohort). The study aims to follow up a cohort of children aged approximately 11 years at baseline into adulthood. At baseline, not only the children but also both their parents were asked to fill in a questionnaire on individual QoL and individual and family confounding variables. The present paper reports on the QoL of the parents of this cohort of children.

The Maastricht population consists of 122 000 inhabitants. Twenty per cent have a non-Dutch nationality and 6% are of non-Western origin. Maastricht consists of 36 residential neighbourhoods, housing between 300 and 8500 inhabitants, and all these neighbourhoods were selected for the present study [23]. These neighbourhoods were defined by local authorities, who defined neighbourhoods throughout the Netherlands. These neighbourhood definitions are widely used and the boundaries, following main roads, are ecologically meaningful.

Socioeconomic deprivation

The city of Maastricht Municipal Statistics Department and Statistics Netherlands (CBS) supplied objective neighbourhood data on various (socioeconomic) variables. In order to summarise these data into a lesser number of underlying constructs, a principal components factor analysis (without rotation) was carried out and the most important identified factor was "socioeconomic deprivation" [23]. Percentage single-parent families, ethnicity, non-voters, unemployment, unemployment more than 1 year, social security, social security more than 3 years, mean income, mean income for persons employed 52 weeks a year, percentages high and low incomes, and percentage economically inactives loaded on this factor. Factor scores were calculated, yielding a continuous variable with mean 0 and unity standard deviation. Higher scores indicated more socioeconomic deprivation and this variable had a normal distribution.

Income inequality

Two different indicators of neighbourhood-level income inequality were constructed: income inequality and house price standard deviation. Both take into account different aspects of the income distribution. The first was a dichotomous variable based on objective neighbourhood variables expressing the proportion of low incomes and the proportion of high incomes (see above). Neighbourhoods with high rankings on both variables (i. e. belonging to the 60% with the highest proportion) were defined as unequal. All other neighbourhoods were defined as equal. One homogeneous affluent neighbourhood was excluded from the analyses, because a home for the elderly with a high proportion of low incomes determined its classification as "unequal", and this home for the elderly was not integrated in the neighbourhood. Ten of the 35 (29%) neighbourhoods scored unequal (Fig. 1), and 31% of the respondents lived in unequal neighbourhoods.

The second income inequality variable, house price standard deviation, was a continuous variable based on mean house price per postal code area. Postal codes areas (as used by the postal services) are defined by six characters, and the Maastricht residential neighbourhoods each contain between 27 and 186 postal codes. Therefore, measures of socioeconomic status of these areas can be used to estimate inequality within the neighbourhood. To estimate postal code socioeconomic status, house prices per postal code between 1998 and 2002 were collected from the website of the Dutch land registry organisation. The prices per year were divided by the mean price per year (to control for increase of the house prices over the years) and these were used as an index of postal code socioeconomic status. The standard deviation of the resulting postal code socioeconomic status variable per neighbourhood was used to estimate inequality. However, this variable was highly correlated with mean postal code house price per neighbourhood and neighbourhood socioeconomic deprivation, in that affluent neighbourhoods showed more variation in house prices. Since the focus of this measure was not on that aspect of inequality, the measure was divided by the mean house price per neighbourhood, which resulted in the variable called "house price standard deviation". This variable is, thus, the standard deviation of the prices relative to the mean price in the neighbourhood.

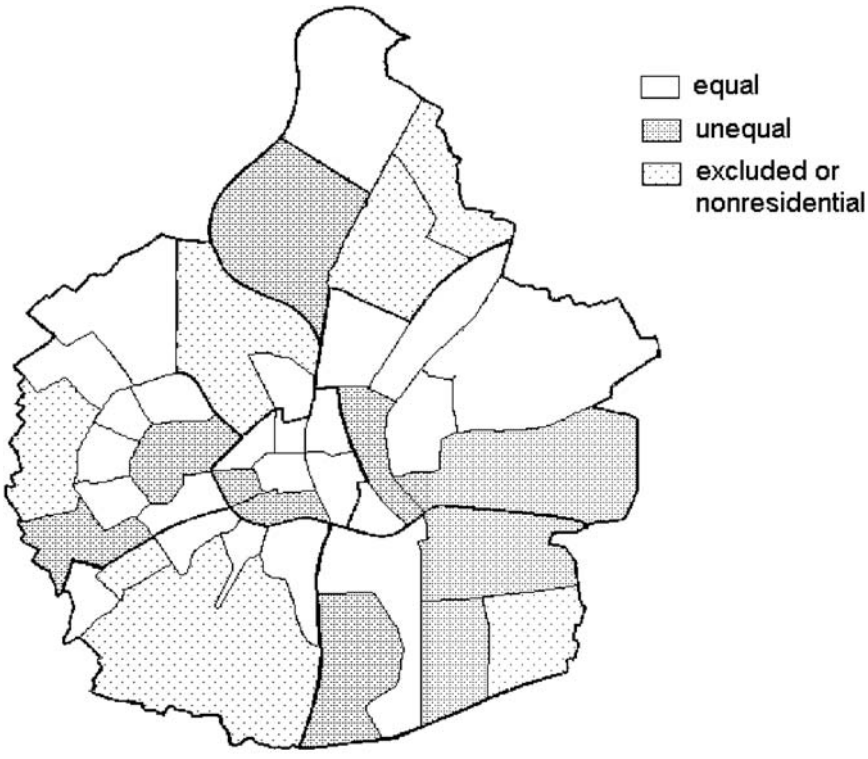

Fig. 1 Income inequality in Maastricht neighbourhoods

Quality of life

In 2000, the doctors of the Youth Health Care Divisions (YHCD) distributed questionnaires to the children as well as their parents (family cohort). The parents' questionnaire included QoL measured with the WHOQOL-BREF [24], an abbreviated version of the WHOQOL-100 quality of life assessment that was translated into Dutch [25]. The WHOQOL-BREF questionnaire contains 26 questions, measuring overall QoL and general health (hereafter overall QoL) and four domains of QoL. Respondents could answer on 5-point Likert scales (e. g. fair to very good, or very unsatisfied to very satisfied). The facets incorporated in the above-mentioned five dimensions of QoL: overall QoL, physical health (domain I), mental health (domain II), social relationships (domain III), and environmental domain of QoL (domain IV) are listed in Table 1 [24]. Higher scores indicated higher levels of QoL. Before analyses all WHOQOL-BREF domains were standardised (sd = 1).

Statistical analyses

Since both parents of one family were asked to fill in a questionnaire, data were grouped according to family, and families were grouped in neighbourhoods. The data, therefore, were part of a multilevel structure with level-one units (individuals) structured into level-two units (families) structured into level-three units (neighbourhoods). These hierarchically structured data were subjected to multilevel regression analysis [26] in order to investigate neighbourhood effects while controlling for individual and family effects. Multilevel or hierarchical linear modelling techniques are a variant of the more often used unilevel linear regression analyses and are ideally suited for the analysis of clustered data. The βs are the regression outcomes of the predictors in the multilevel model and can be interpreted identically to the estimates in the unilevel analyses. All multilevel analyses were performed using MLwiN [27].

All analyses testing for the associations between the neighbour-

Table 1 WHOQOL-BREF domains of QoL [24]

	Overall and general health	Physical health	Mental health	Social relationships	Environment
Facets	• overall QoL • general health	• pain • energy • sleep • mobility • activities daily living • medication • work	• positive feelings • think • self-esteem • body • negative feelings • spirituality	• personal relationships • social support • sex	• safety • home • finances • services • information • leisure • environment • transport
Maastricht descriptives					
Mean	8.0	28.4	22.8	11.8	31.6
SD	1.4	4.5	3.4	2.0	4.7
Min	2	8	9	4	9
Max	10	35	30	15	40

hood-level variables socioeconomic deprivation and income inequality, and individual-level QoL were controlled for family-level occupational status (ISEI92) [28], educational status, welfare recipient status, and single-parent family. Occupational status and educational status were estimated using data of the parent with the highest profession and education, respectively. Including these two measures in the analyses guarantees satisfactory control for individual-level socioeconomic status in the Netherlands [29]. Because effect non-linearities were observed for occupational status, this continuous variable was collapsed into five categories. Furthermore, models included individual-level age group (26–37, 38–41, 42–44, and 45–62 years) and gender. Occupational status, educational status, and age group were entered as dummy variables in the equation, with the lowest category (low occupational status, elementary or lower education, age ≤37 years) being the reference category. This resulted in the following multilevel linear regression models:

$$\begin{aligned} QoL_{ijk} = {} & \beta_0 + \beta_1 \text{ deprivation}_k + \beta_2 \text{ income inequality variable}_k \\ & + \beta_{3-6} \text{ occupational status dummy } (1-4)_{jk} \\ & + \beta_{7-11} \text{ educational status dummy } (1-5)_{jk} \\ & + \beta_{12} \text{ family welfare recipient}_{jk} + \beta_{13} \text{ single parent family}_{jk} \\ & + \beta_{14-16} \text{ age group dummy } (1-3)_{ijk} + \beta_{17} \text{ gender}_{ijk} \\ & + \nu_k + \mu_{jk} + \varepsilon_{ijk,} \end{aligned}$$

in which QoL was one of the five QoL dimensions of the WHOQOL-BREF and the income inequality variable was either income inequality or house price standard deviation. The multiple error terms reflect residual variation at each level: individual (ε_{ijk}), family (μ_{jk}) and neighbourhood(ν_k). Thus, every level has its own variance.

In addition, we analysed the following interaction effects: 1a) interaction between the four dummies of individual occupational status and deprivation; 1b) interaction between the five dummies of educational status and deprivation; and 2) interaction between neighbourhood deprivation and the two neighbourhood income inequality variables.

Results

Sixty per cent of the families returned one or both adult questionnaires. A total of 1082 parents responded. Most parents were aged between 35 and 45 years and most children were aged 11 years (75 %). Fourteen per cent of the families were single-parent families, and 24 % of the families reported a profession for which only elementary or lower level education was required.

Table 1 presents descriptives of the WHOQOL-BREF domains. Income inequality and house price standard deviation were weakly correlated (Pearson correlations: 0.28 p = 0.09; Table 2). Furthermore, income inequality was not associated with socioeconomic deprivation.

Table 2 Pearson correlations between income inequality and socioeconomic deprivation variables

	Income inequality (n = 35)	House price standard deviation	Mean house price
House price standard deviation (n = 36)	0.28	1	
Mean postal code house price per neighbourhood (n = 36)	−0.06	0.62**	1
Neighbourhood socioeconomic deprivation (n = 35)	−0.11	−0.06	−0.54**

** $p < 0.01$

Income inequality

Neither the crude analyses nor the analyses of the models including confounders showed any associations of income inequality or house price standard deviation with any of the outcome variables (Table 3). No interaction effects between socioeconomic deprivation and any of the income inequality variables were found. Furthermore, analyses did not show any interaction effects between neighbourhood socioeconomic deprivation and individual occupational and educational status in any of the QoL dimensions (data not shown).

Individual-level variables and socioeconomic deprivation

Family educational status and occupational status were associated in a non-linear fashion with overall QoL, physical health, and environmental QoL (Table 3). Furthermore, parents living in welfare-receiving families and single-parent families had lower levels of overall QoL, physical health, mental health, social relationships, and environmental QoL. Fathers reported better physical health and mental health, and worse perceived social relationships than mothers (data not shown).

Lower socioeconomic deprivation scores were associated with a better overall QoL, physical health, mental health, and environmental QoL. However, the association with the environmental QoL scale was the only one that remained statistically significant after correction for individual confounders (Table 3).

Discussion

Mental health perceptions

The results showed that income inequality did not have any impact on QoL. The fact that the data did not show interaction effects between individual socioeconomic status and neighbourhood socioeconomic deprivation is a further suggestion for the relative lack of importance of income inequality at the neighbourhood level. In contrast, socioeconomic deprivation was associated with environmental QoL (domain IV), and this association remained after controlling for individual socioeconomic status. Socioeconomic deprivation was also associated with other domains of QoL, but associations were no longer statistically significant after including confounders. In addition, associations between neighbourhood socioeconomic deprivation and QoL have been reported previously [4, 23]. On the other hand, although low levels of segregation may have resulted in larger income inequality within the Maastricht neighbourhoods, we could not find any effects of income inequality.

Thus, there is evidence that QoL as a measure of mental state is associated with socioeconomic deprivation, but there is no evidence for an association with income

Table 3 Multilevel regression analysis; associations between income inequality and dimensions of QoL[1]

	Overall QoL and general health β (95% CI)	Physical health β (95% CI)	Mental health β (95% CI)	Social relationships β (95% CI)	Environment β (95% CI)
A Crude					
1) Income inequality (yes/no)	0.10 (−0.14; 0.35)	0.02 (−0.20; 0.24)	0.02 (−0.13; 0.17)	−0.02 (−0.18; 0.15)	0.15 (−0.13; 0.42)
2) House price standard deviation[2]	0.35 (−1.06; 1.75)	0.12 (−1.15; 1.40)	0.23 (−0.72; 1.19)	−0.66 (−1.70; 0.38)	−0.15 (−1.69; 1.39)
3) Socioeconomic deprivation	−0.14** (−0.25; −0.04)	−0.17† (−0.25; −0.08)	−0.10** (−0.18; −0.02)	−0.04 (−0.12; 0.05)	−0.27† (−0.36; −0.19)
B Model with individual variables only[3]					
Occupational status					
Low (reference)	0	0	0	0	0
	0.03 (−0.19; 0.25)	0.17 (−0.03; 0.37)	0.04 (−0.18; 0.26)	0.08 (−0.16; 0.33)	−0.01 (−0.23; 0.20)
	0.28* (0.05; 0.51)	0.32** (0.11; 0.54)	0.16 (−0.07; 0.40)	0.10 (−0.16; 0.35)	0.24* (0.00; 0.47)
	0.12 (−0.11; 0.36)	0.17 (−0.05; 0.38)	0.08 (−0.16; 0.33)	0.07 (−0.19; 0.34)	0.13 (−0.11; 0.37)
High	0.12 (−0.16; 0.40)	0.13 (−0.13; 0.39)	0.04 (−0.25; 0.33)	−0.06 (−0.38; 0.25)	0.19 (−0.09; 0.48)
Educational status					
Elementary (ref)	0	0	0	0	0
Lower secondary	0.34* (0.06; 0.62)	0.32* (0.05; 0.58)	0.31 (0.02; 0.60)	0.05 (−0.27; 0.38)	0.56† (0.27; 0.84)
Intermediate vocational	0.13 (−0.12 0.38)	0.13 (−0.11; 0.36)	0.19 (−0.07; 0.44)	−0.12 (−0.41; 0.16)	0.41** (0.15; 0.66)
Higher secondary	0.22 (−0.05; 0.50)	0.26 (−0.01; 0.52)	0.22 (−0.06; 0.51)	−0.13 (−0.44; 0.18)	0.61† (0.33; 0.89)
Higher vocational	0.34* (0.07; 0.61)	0.23 (−0.02; 0.48)	0.20 (−0.08; 0.48)	−0.08 (−0.38; 0.22)	0.65† (0.38; 0.92)
University	0.45** (0.13; 0.76)	0.43** (0.13; 0.72)	0.27 (−0.05; 0.59)	−0.07 (−0.42; 0.28)	0.88† (0.56; 1.19)
Welfare recipient	−1.09† (−1.42; −0.76)	−1.17† (−1.48; −0.85)	−0.58** (−0.93; −0.23)	−0.45* (−0.84; −0.06)	−0.49** (−0.83; −0.15)
C) Final models[4]					
1) Income inequality	0.02 (−0.18; 0.21)	−0.08 (−0.24; 0.08)	−0.03 (−0.17; 0.11)	−0.05 (−0.20; 0.10)	0.01 (−0.15; 0.17)
Socioeconomic deprivation	−0.01 (−0.11; 0.10)	−0.05 (−0.14; 0.03)	−0.04 (−0.12; 0.05)	−0.03 (−0.13; 0.06)	−0.10* (−0.19; −0.01)
2) House price standard deviation[5]	0.39 (−0.76; 1.54)	0.25 (−0.75; 1.24)	0.42 (−0.51; 1.35)	−0.10 (−1.13; 0.92)	−0.22 (−1.22; 0.79)
Socioeconomic deprivation	−0.01 (−0.11; 0.09)	−0.05 (−0.14; 0.04)	−0.04 (−0.13; 0.04)	−0.03 (−0.12; 0.06)	−0.09* (−0.18; −0.04)

[1] Higher values of the outcome variables indicating better QoL. Thus, βs below 0 indicate a negative influence on QoL and βs above 0 a positive influence
[2] Standard deviation of postal code house price per neighbourhood/mean house price per neighbourhood
[3] Controlled for occupational status, educational status, welfare recipient status, age group, gender, and single-parent family
[4] Controlled for occupational status, educational status, welfare recipient status, age group, gender, single-parent family, and socioeconomic deprivation
[5] Based on house price per postal code and controlled for mean house price per neighbourhood
* $p < 0.05$; ** $p < 0.01$; † $p < 0.001$

inequality and the sense of deprivation relative to direct neighbours, such as the affluent owner occupying properties across the street.

Social capital

An effect of neighbourhood-level income inequality was nevertheless hypothesised for the present study, because inhabitants of non-homogeneous neighbourhoods belong to different income groups, resulting in lower levels of social capital [5, 9], which in turn is associated with various health and mental health outcomes [5, 11]. This pathway would operate at the neighbourhood level, because it is defined through contacts with adjacent neighbours [20], and a previous study did report effects of neighbourhood social capital in Maastricht [23]. Therefore, the data suggest that neighbourhood social capital has effects independent of neighbourhood income inequality.

An explanation for not finding any effects of income inequality could be that although poor inhabitants of an affluent neighbourhood feel relatively disadvantaged, they benefit from the same resources and amenities as their affluent neighbours. These two opposite effects could have neutralised each other, resulting in not finding any effects of income inequality.

Population size

The present findings on QoL and previous findings on mortality suggest that population size of the area under study is crucial in income inequality analyses. An aggregate level study showed an interaction effect of income inequality and population size at county level in the effect on mortality [19]. In addition, except for one recent study [30], all multilevel studies that did find effects of income inequality after controlling for individual socioeconomic status were studying state or county income inequality and mortality [6–8, 31] or perceived health [10]. This indicates that the reference frame of individuals is not located within the neighbourhood nor within small counties, but may be determined nationwide, for instance by television. Thus, although we found evidence for what has been called the "absolute" income hypothesis at neighbourhood level (as opposed to the "relative" income hypothesis), the effects of objective so-

cioeconomic deprivation may also be the result of a person's sense of their status, but then using a broader reference frame. Therefore, guided by the work of Wilkinson [20], a more specific relative income hypothesis, operating in geographical areas with large population sizes only (i. e. large counties or larger), may be specified. Arguably perceptions and mental health may have a higher sensitivity to change, and are, thus, more easily affected by a risk factor. Therefore, effects of income inequality on perceptions of (mental) health may be even stronger than on mortality. However, more research on state or country level income inequality and mental health is needed.

Methodological issues

The Pearson correlation coefficient between the two income inequality estimates was low (0.28, $p < 0.1$, $n = 35$), which indicated that both measures tapped into different aspects of income inequality. Income inequality only takes into account persons at both ends of the income distribution, while house price standard deviation yields overall estimates. A previous study also reported low correlations (between 0.04 and 0.40) between inequality at the bottom end and income inequality at the middle of the distribution [19]. Previous research used other income inequality indices, like the Robin Hood and the GINI index [5, 7, 8, 15], which were not available in the present study. We chose two different estimates of income inequality because there is no agreement upon the best measure and previous comparisons yielded different results [19]. Fortunately, both measures of income inequality as well as the individual by neighbourhood socioeconomic status interaction yielded the same results, which made our conclusions stronger.

The first income inequality measure was rather crude. However, it selects those neighbourhoods having both a high percentage of high incomes and a high percentage of low incomes and, therefore, has face validity. The other measure, house price standard deviation, was determined using a measure of socioeconomic status per postal code, based on house prices. Since the essence of the inequality exposure was not variation in house prices in rich neighbourhoods, we divided our measure by mean socioeconomic status per neighbourhood based on postal code house price. This resulted in a measure of house price standard deviation relative to the mean house price in the neighbourhood (i. e. as a fraction of the mean). One disadvantage of the house price standard deviation measure is that house price is not available from postal codes with rented houses only. Excluding these postal codes may lead to an underestimation of the variance (i. e. income inequality), because persons having a lower socioeconomic status usually live in rented houses. Therefore, we generated another measure in which postal code socioeconomic status was estimated when house price was not available, using data on rented houses. However, this measure was strongly associated with neighbourhood socioeconomic status, even when the measure was divided by the mean postal code socioeconomic status per neighbourhood [Pearson correlation with mean socioeconomic status (based on house price): 0.72; with socioeconomic deprivation: 0.43], in that rich neighbourhoods showed larger variation than poor neighbourhoods. Therefore, this measure was positively associated with all outcome measures, the more inequality the higher the levels of QoL.

Secondly, although the overall response rate was 60 %, the response rate of the family cohort varied considerably per school (20 %–84 %). As the response rates per neighbourhood were not associated with neighbourhood socioeconomic deprivation (Pearson correlation: –0.27, $p > 0.15$), non-response is unlikely to have biased the results.

Theoretically, variance at each level warrants including that level in the multilevel analyses [26]. However, empty models showed that neighbourhood level variance (σ_μ^2) was statistically significant for only three of the five measures of QoL: overall QoL, physical health, and environmental QoL, but not for mental health and social relationships. However, because this neighbourhood variance was statistically significant for some of our outcome variables, we may conclude that neighbourhoods do matter. This supports the rationale for studying neighbourhood effects in all outcome variables. Moreover, neighbourhood researchers tend to analyse neighbourhood effects, even when the intraclass correlation and the neighbourhood variation are low, and it is generally held that this is warranted [32].

Furthermore, all respondents were parents of a group of children aged approximately 11 years. Therefore, variability in this group of adults may be lower than in other groups of adults. However, analyses repeated in another group of adults, as described in a previous paper [4], yielded similar results. Absolute levels of neighbourhood socioeconomic deprivation were associated with three of the five QoL measures (satisfaction, mental health, perceived mental health), although one of the associations was statistically imprecise by conventional alpha. On the contrary, none of the QoL variables were associated with house price variance or income inequality after including socioeconomic deprivation in the models.

Finally, residents have been reported to identify different neighbourhood boundaries than those defined by the authorities [33], and most individuals perceive their neighbourhood as comprising their own street and perhaps one or two side-streets (perceived neighbourhoods). The neighbourhoods defined in the present study are larger and some are heterogeneous. Smaller areas within the unequal income neighbourhoods are more equal. For example, the heterogeneous neighbourhood "Wyckerpoort" consists of three more homogeneous areas: a deprived area, a middle-class area, and an affluent area. However, when the areas are smaller, inhabitants conceptually have more contacts with inhabi-

tants from adjacent areas, and results would likely have shown even weaker effects of income inequality.

Conclusion and implications

We may conclude that neighbourhood-level income inequality is not important for the mental health of the residents of Maastricht neighbourhoods. A more specific relative income hypothesis, operating in geographical areas with large population sizes only (i. e. large counties or larger), may be specified [20]. Thus, results of the present paper do not suggest that reducing income inequality will have an effect on mental health related QoL.

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Chapter 3

Adolescents

3.1 Children's health-related quality of life and neighbourhood social capital and deprivation

Neighbourhood objective socio-economic indicators and community-reported subjective measures of social capital were examined in relation to children's health-related quality of life. Three different data-sources were used: 1) objective neighbourhood socio-economic indicators, 2) subjective neighbourhood data on social capital, and 3) individual data of a family cohort study, including questions on children's health-related quality of life, and family socio-economic status. Multilevel analyses were conducted using both neighbourhood level and individual level data.

Neighbourhood socio-economic status and social capital were associated. Measures of socio-economic deprivation and social capital were both non-specifically associated with children's general health and satisfaction, independent of possible individual-level confounders. However, children's mental health and behaviour were specifically associated with one aspect of social capital, the degree of informal social control in the neighbourhood.

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Children's health-related quality of life, neighbourhood socio-economic deprivation and social capital. A contextual analysis

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Abstract

Neighbourhood objective socio-economic indicators and community-reported subjective measures of social capital were examined in relation to children's health-related quality of life in the Netherlands. Three different data-sources were used: (1) objective neighbourhood socio-economic indicators, (2) subjective neighbourhood data on social capital, and (3) individual data of a family cohort study, including questions on children's health-related quality of life, and family socio-economic status. Multilevel analyses were conducted using both neighbourhood level and individual level data.

Neighbourhood socio-economic status and social capital were associated. Measures of socio-economic deprivation and social capital were both non-specifically associated with children's general health and satisfaction, independent of possible individual-level confounders. However, children's mental health and behaviour were specifically associated with one aspect of social capital, the degree of informal social control in the neighbourhood.

Keywords: Social capital; Socio-economic deprivation; Residential instability; Children; Quality of life; Perceived health; Mental health; Netherlands

Introduction

There is accumulating evidence on both sides of the Atlantic that the shared social environment at the neighbourhood level exerts significant effects on the health and quality of life of the persons living there, independent of their individual-level risk profile (Coleman, 1988, 1990b; Diez Roux et al., 2001; Driessen, Gunther, & Van Os, 1998; Kalff et al., 2001; Sampson, Raudenbush, & Earls, 1997; Van Os, Driessen, Gunther, & Delespaul, 2000). Since the publication of Robert Park's seminal paper in 1915 "The City: Suggestions for the Investigation of Human Behaviour in the City Environment" (Park, 1967), generations of "Chicago School" sociologists and their students have been documenting how neighbourhood-level ecological factors have affected social disorganisation and social cohesion, both in adults and children (Janowitz, 1952; Kurtz, 1984; Shaw & McKay, 1969; Smith, 1988; Wirth, 1957). Specifically related to medically relevant outcomes, neighbourhood measures that have been reported to contribute to an increased risk of poor general and mental health outcomes include measures of

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socio-economic deprivation (Diez Roux et al., 2001; Driessen et al., 1998; Kalff et al., 2001) and, more recently, measures of "social capital" (Coleman, 1988, 1990b; Kawachi, Kennedy, & Wilkinson, 1999b; Sampson, Morenoff, & Earls, 1999; Sampson et al., 1997).

Adolescence is an age of increasing independence and autonomy, with more time being spent in neighbourhood settings, away from the family and the formal social control institution of the school (Allison et al., 1999). Neighbourhood characteristics differ because of residential segregation and these differences influence child development and health (Garcia Coll et al., 1996). Neighbourhood poverty and socio-economic deprivation have been reported to have negative effects on children's mental health (Kalff et al., 2001), internalising behaviour and school achievement (Duncan, Brooks Gunn, & Klebanov, 1994). Local community forms of deprivation have been defined by an array of social indicators that characterize a so-called "underclass" (Kasarda, 1993; Wilson, 1987). Studies have shown that these indicators mark the specific pathways where adolescents living in these communities are led to negative behavioural outcomes. For example, James Quane and Bruce Rankin have developed a causal model of the direct and mediated effects of neighbourhood disadvantage and family structure on youth employment expectations (Quane & Rankin, 1998). The authors show that the employment expectations of adolescents are significantly lower in both broken family and welfare homes in poor neighbourhoods compared to adolescents in households in middle-class neighbourhoods. Neighbourhood deprivation was also indirectly associated with reduced expectation through the pathway of exposure of the adolescents in these areas to peers who identify with deviant norms. Related to the nonnormative social environment found in deprived neighbourhoods, chronic exposure to community violence has been argued to be associated with a wide variety of mental health problems in children, ranging from posttraumatic stress disorder to anxiety (Osofsky, 1995; Richters & Martinez, 1993). Therefore, neighbourhood contextual effects may be especially important from a developmental perspective, their cumulative effect impacting most on children and adolescents who grow up in these environments (Furstenberg, 2001; Kalff et al., 2001).

More recent work has demonstrated that neighbourhood measures of "social capital" are also associated with the health of both adults (Kawachi et al., 1999b) and children (Aneshensel & Sucoff, 1996). The objective of the present paper, therefore, is to study not only socio-economic factors but also social capital and their association with child outcomes.

In contrast to the objective socio-economic measures at the neighbourhood level, the concept of neighbourhood social capital has been advanced to emphasize the aspect of human agency in social life and its role in collective action (Emirbayer & Goodwin, 1994; Portes, 1998; Portes & Sensenbrenner, 1993). Coleman and Putnam are considered the architects of much of the contemporary discourse on social capital in the sociology literature (Coleman, 1990a; Putnam, 1993). Kawachi et al. have summarized their theories and have "defined" social capital as "those features of social organizations—such as networks of secondary associations, high levels of interpersonal trust and norms of mutual aid and reciprocity—which act as resources for individuals and facilitate collective action" (Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997b). The concept has had a widespread and popular reception as a way of denoting the many kinds of resources that can be appropriable from direct and indirect interpersonal relations and personal network structures (Sandefur & Laumann, 1998). Methodologically and empirically, it can be further conceptualised as social integration measured as a collective characteristic (Sampson et al., 1997) and the measurement relies largely on the subjective assessments of the residents of the neighbourhood social environment. For example, collective efficacy has been used to account for the process of social capital formation whereby the perceived level of cohesion and trust between neighbours is tied to their shared beliefs in their capability of collective action (Sampson et al., 1999). Collective efficacy is largely a matter of social integration that leads to the capacity to achieve common goals. This collective efficacy is analytically similar, but at a clearly different level, than the individual characteristic of self-efficacy of individuals to succeed in reaching personal goals (Sampson et al., 1997). In the case of children, collective efficacy involves specific spatial dynamics of intergenerational closure, social exchange and shared child control, which contribute to the deficits and disadvantages in the social environment (Sampson et al., 1999).

Five different plausible pathways by which social capital might influence individual health have been described, including promotion of a more rapid diffusion of health information, increased likelihood that healthy norms or behaviour are adopted, social control over deviant health-related behaviour (collective efficacy), increased access to local services and amenities and psychosocial processes such as affective support, self-esteem and mutual respect (Kawachi et al., 1999b).

Generally, more deprived neighbourhoods may also be lower in social capital. However, anecdotal evidence suggests that inhabitants of some socio-economically deprived neighbourhoods may help and trust each other, whereas conversely people in affluent neighbourhoods may not develop any ties with their neighbours. Therefore, it does not follow that social capital is per definition a function of deprivation and the first

objective of the present paper is to examine whether and in what way socio-economic deprivation and social capital are associated.

The second objective is to study the associations between socio-economic factors and social capital on the one hand and different dimensions of quality of life and behaviour on the other in children at the beginning of the period of adolescence. Furthermore, the question whether the effects of socio-economic deprivation and social capital on child quality of life occur independently of each other was examined. It was hypothesised that both high socio-economic deprivation and low social capital would independently reduce children's health-related quality of life.

In addition, the sense of relative deprivation may be damaging to health (Fiscella & Franks, 1997; Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997a). Therefore, family SES may have different effects in neighbourhoods with lower or higher socio-economic deprivation. Statistically this can be expressed as an individual by area socio-economic status interaction.

Methods

Research design

The Maastricht population counts 122 000 inhabitants and is fairly homogeneous in ethnic terms (CBS (Dutch National Statistics Institute). 2001). Twenty percent have a non-Dutch nationality with six percent of these having a non-Western origin. These percentages of migrants are low compared to large Dutch cities like Amsterdam (44%, 31%, respectively) and Rotterdam (40%, 30%), but similar to the percentages in most other small cities in the Netherlands. Maastricht consists of 36 residential neighbourhoods and 5 non-residential neighbourhoods (e.g. industrial estates or nature conservation areas). The boundaries of these neighbourhoods follow main roads and are ecologically meaningful. Each of the 36 neighbourhoods houses between 300 and 8500 inhabitants (all ages).

The university psychiatric department and the municipal health centre collaborated in a longitudinal cohort study of children and their families in the city neighbourhoods. The study aims to follow-up a cohort of children now around 11 years of age into adulthood. The aim of the longitudinal study is to obtain insight in the collective and individual determinants of health-related quality of life. This article uses the baseline measurements of the children, their families and the neighbourhoods they live in. These measurements included objective neighbourhood socio-economic measures, and neighbourhood-level subjective measures of social capital as well as individual-level children's quality of life and other individual and family variables.

Neighbourhood socio-economic measures

The city of Maastricht statistics department and the National Statistics Institute (CBS) supplied objective neighbourhood data on the following variables: percentage single parent families, two-parent families, single persons, departure, settlement, mobility within neighbourhoods, total mobility, mobility balance, ethnicity (defined as non-Dutch nationality), non-voters, school absenteeism, unemployment benefit, unemployment benefit more than 1 year, unemployment benefit more than 3 years, social welfare benefit, social welfare benefit more than 3 years, mean income, mean income for persons employed 52 weeks per year, proportion high incomes, proportion low incomes, and proportion economically inactives. In order to summarize these data into a lesser number of underlying constructs a factor analysis (principal factors without rotation) was carried out. The two identified factors, hereafter called "socio-economic deprivation" and "residential instability", explained 70.0% of the total variance, and both can be conceived as socio-economic indicators. Percentage single parent families, ethnicity, non-voters, unemployment, unemployment more than 1 year, social security, social security more than 3 years, mean income, mean income for persons employed 52 weeks a year, percentages high and low incomes, and percentage economically inactives loaded on socio-economic deprivation. Single persons and all mobility variables loaded on residential instability. Regression factor scores were calculated for both the socio-economic deprivation and residential instability constructs, yielding continuous variables with mean 0 and unity standard deviation. Higher scores indicate more socio-economic deprivation and more residential instability. Socio-economic deprivation had a normal distribution; residential instability was somewhat skewed to the left.

Social capital

In order to assess social capital, approximately 200 inhabitants aged 20 to 65 years were randomly selected from each of 36 Maastricht neighbourhoods, using the municipal database (hereafter: community survey). These inhabitants received a questionnaire on social capital, which they were asked to send back. Social capital was measured using two collective efficacy scales: informal social control (hereafter: ISC) and social cohesion and trust (hereafter: SC&T), developed by Sampson and colleagues (Sampson et al., 1997). Both scales were translated into Dutch and back translated into English. In order to adapt the ISC scale to the Dutch situation, five items corresponding to typical Dutch concerns were added (see the appendix). The ISC scale measures the willingness to intervene in hypothetical neighbourhood-threatening situations, for example

in the case of children misbehaving or the opening of a brothel in the street. This scale is conceived in such a way that respondents are independent informants about their neighbours' willingness to intervene. The SC&T scale measures bonds and trust among the residents of the neighbourhood. As the Maastricht study focussed on children, extra items about children were added and a separate scale was devised, in addition to and based on the adult SC&T scale, using questions on social cohesion and trust in children (see appendix). Only respondents having children were asked to supply information on this scale (hereafter: SC&Tc). Sum scores were constructed of all social capital scales, higher scores indicating lower levels of informal social control and lower levels of social cohesion and trust. Before analyses sum scores were standardized to unity standard deviation.

Health-related quality of life and behaviour

All children living in Maastricht and attending group 8 of the Dutch primary school for children aged approximately 11 or 12 years, as well as the parents of these children (hereafter: family sample), were asked to fill in questionnaires on quality of life and individual and family characteristics. The children's questionnaire consisted mainly of the Child Health Questionnaire (CHQ) (Landgraf, Abetz, & Ware, 1996; Raat, Bonsel, Essink Bot, Landgraf, & Gemke, 2002; Wulffraat et al., 2001). The CHQ is a generic health instrument that measures the behaviour and physical, emotional, and social well-being of children. Since, in the current study, the children were asked to report on their own quality of life, the self-report CHQ Child Form consisting of 87 items (CHQ-CF87) was used. The CHQ-CF87 demonstrated a satisfactory level of internal consistency, reliability and validity as did the parent form versions of the instrument (Landgraf et al., 1996). Previous research showed good agreement between the child form and the parent form of the CHQ (Levi & Drotar, 1999; Sawyer, Antoniou, Toogood, & Rice, 1999). The CHQ-subscales selected for the analyses were a priori selected as general health, mental health, self-esteem and behaviour.

The general health scale assesses overall health, illness, and resistance/susceptibility to sickness. Mental health is based on a general well-being scale, and measures the frequency of both negative (anxiety, depression) and positive states (positive affect). The self-esteem scale includes items on satisfaction with abilities, overall-life, and getting along. The behaviour scale assesses overt behaviour as a component of mental health, including items on aggression, delinquency, hyperactivity/impulsivity, and social withdrawal. The items of all scales refer to the past four weeks and are scored on a five point Likert scale. In addition to the CHQ, items on satisfaction with different aspects of life were added to the children's questionnaire. These items were scored on a five point Likert scale from very satisfied to very unsatisfied and enquire about satisfaction with friends in the neighbourhood, friends at school, school in general, teacher, school records, the neighbourhood in general, playing in the neighbourhood, safety of the neighbourhood, home, leisure activities, and the relationship with parents. Both the CHQ self-esteem items and the satisfaction items enquired about similar aspects of life and it was expected that all items would load on the same underlying construct. Factor analyses of the self-esteem and satisfaction items (principal factor) identified one factor, explaining 77% of the variance. The satisfaction scale, therefore, was constructed combining the self-esteem and the satisfaction items. This scale was constructed in the same way as the original CHQ scales (Landgraf et al., 1996). Therefore, the general health, mental health, self-esteem, satisfaction and behaviour scales could all range from 1 to 100 and were all scored positively, higher scores indicating better outcome.

Individual level confounders

Family socio-economic status (family SES) and welfare recipient status were the individual level equivalents of neighbourhood socio-economic deprivation and, therefore, were hypothesized to be confounders in both the community survey, studying the association between neighbourhood socio-economic measures and social capital, and the family cohort, studying the association between these neighbourhood variables and children's health-related quality of life.

Respondents' SES (community survey) and family SES (family cohort) were assessed using both occupational status and educational status. Including these two measures in the analyses guarantees satisfactory control for individual level socio-economic status in the Netherlands (Van Berkel-Van Schaik, & Tax, 1990). Occupational status was measured using information on current or last profession, scored according to the International Socio-Economic Index of occupational status ISEI-92 (Ganzeboom, De Graaf, & Treiman, 1992). In addition, the questionnaires assessed the highest level of completed education. Family occupational and educational status were based on the parent with the highest occupational status and educational status, respectively.

Guided by previous work (Driessen et al., 1998; Kalff et al., 2001), single marital status in the community survey and single parent family status in the family cohort were also considered as potential confounders, as were gender and age. In the family study, grade retention was included as the age variable, because only

the children who doubled a grade were older than the other children.

Finally, variables measuring the quality of child–parent interaction were included as the family-level equivalent of neighbourhood ISC, in order to ensure control for family level processes. The parent–child interaction variables were defined as parental perceived difficulty in child raising and the child's satisfaction with the relationship with their parents and child's satisfaction with the relationships with their relatives. The last two were both items of the CHQ (see above). Parental perceived difficulty in child raising was measured using the NOSIK, a Dutch questionnaire consisting of 25 items, such as "my child engages in activities that worry me a great deal", "I have much more problems raising my child than expected", and "If I tell my child not to do something he/she will do it again anyway" (Brock, Vermulst, Gerris, & Abidin, 1992). The sum score of all 25 items was used in the present analyses (Brock et al., 1992).

No other variables were hypothesized to confound the associations analysed in the current paper.

Statistical analysis

All analyses were performed using STATA (version 7, StataCorp., 2001). Data were grouped according to neighbourhood and were, in statistical terms, part of a multilevel structure with level-one units (individuals) clustered into level-two units (neighbourhoods). These hierarchically structured data were subjected to multilevel regression analysis (Snijders & Bosker, 1999) in order to investigate neighbourhood effects while controlling for individual effects. Multilevel or hierarchical linear modelling techniques are a variant of the more often used unilevel linear analyses and are ideally suited for the analysis of clustered data, in this case consisting of multiple persons clustered within a single neighbourhood. The βs are the fixed regression coefficients of the predictors in the multilevel model and can be interpreted identically to the estimate in the unilevel linear regression analyses. In the present analyses, these βs indicate how much children's quality of life improves/deteriorates when the socio-economic indicator or social capital variable changes one standard deviation.

The analyses testing for the association between neighbourhood socio-economic measures and social capital (first objective) were controlled for occupational status, educational status, welfare recipient status, single marital status, age group (20–34 years, 35–54 years, 55–65 years) and gender. Because effect non-linearities were observed for occupational status, this continuous variable was collapsed into 5 categories. Occupational status, educational status, and age group were entered as dummy variables in the equation. This resulted in the following multilevel model:

$$\begin{aligned}\text{ISC} = {} & \beta_0 + \beta_1\ \text{deprivation}_j + \beta_2\ \text{residential instability}_j \\ & + \beta_{3-6}\ \text{occupational status dummy}(1-4)_{ij} \\ & + \beta_{7-11}\ \text{educational status dummy}(1-5)_{ij} \\ & + \beta_{12}\ \text{welfare recipient}_{ij} \\ & + \beta_{13}\ \text{single marital status}_{ij} \\ & + \beta_{14-15}\ \text{age dummy}(1-2)_{ij} \\ & + \beta_{16}\ \text{gender}_{ij} + \mu_j + \varepsilon_{ij}.\end{aligned}$$

This model was used for the other dependent variables (SC&T and SC&Tc) as well. All models were tested for deviation from linearity by adding squared exposure terms to the models, and since none of the tests showed statistically significant deviation from linearity, socio-economic deprivation and residential instability were entered as continuous variables throughout.

The analyses testing for the association between neighbourhood variables and children's quality of life (second objective) were controlled for family occupational status, family educational status, family welfare recipient status, single parent family status, child's gender (1 male, 2 female) and grade retention. Again occupational status and educational status were entered as dummy variables in the equation:

$$\begin{aligned}\text{Outcome} = {} & \beta_0 + \beta_1\ \text{neighbourhood variable}_j \\ & + \beta_{2-5}\ \text{occupational status dummy}(1-4)_{ij} \\ & + \beta_{6-10}\ \text{educational status dummy}(1-5)_{ij} \\ & + \beta_{11}\ \text{family welfare recipient}_{ij} \\ & + \beta_{12}\ \text{single parent family}_{ij} \\ & + \beta_{13}\ \text{child's gender}_{ij} + \beta_{14}\ \text{grade retention}_{ij} \\ & + \mu_j + \varepsilon_{ij}.\end{aligned}$$

In which the outcome variable was general health, mental health, self-esteem, satisfaction or behaviour, and the neighbourhood variable was either socio-economic deprivation, residential instability, ISC, SC&T or SC&Tc. Since higher scores on the outcome variables indicated better quality of life and higher scores for the neighbourhood variables indicated more deprivation and lower levels social capital, we expected the βs of the neighbourhood variables to be negative.

Again, all neighbourhood associations were tested for deviation from linearity, and since none of the tests showed statistically significant deviation from linearity, all neighbourhood variables were entered as continuous variables throughout. Because of the high correlations between them, all neighbourhood variables were first entered in separate models. In addition, a model was examined with all neighbourhood variables entered jointly (β_1 deprivation$_j$ + β_2 residential instability$_j$ + β_3

$ISC_j + \beta_4$ SC&T$_j$), with the exception of SC&Tc, in order to assess to what degree any effects of these neighbourhood variables were mutually independent.

Child's satisfaction with the relationship with their parents, child satisfaction with the relationship with relatives, and parental perceived difficulty in child raising were entered as family equivalents of social capital as explained above. In addition, an a priori interaction term as described earlier was added to the final model: individual-level SES by neighbourhood socio-economic deprivation.

Diagnostics for regression were performed to check whether the conditions for regression had been met with the residuals being normally distributed and their variance being constant, in all above described regression models.

Results

Response and respondents

Community survey

Forty-eight percent of the 7236 selected inhabitants responded. Of these, 48% were male, 34% were aged between 20 and 34 years, 46% were aged between 35 and 54 years and 20% were aged between 55 and 65 years. Thirty-two percent of the respondents required only elementary or lower level education for their profession. Women, persons aged between 55 and 65 years, and persons without a job (i.e. unemployed, housewife, etc.) were slightly over-represented in the group of respondents, whereas singles (including students) were under-represented, relative to the general population. The response rate varied between the neighbourhoods (32–65%) and the rate was lower in neighbourhoods with higher socio-economic deprivation scores (Pearson correlation: -0.67 $p<0.001$).

Family sample

Fifty-seven percent of the children responded and 60% of the families returned a parent questionnaire. Fifty-four percent of the families returned both one adult questionnaire and the child questionnaire. The response rate varied considerably between schools (20–85%), and was correlated with neighbourhood socio-economic deprivation (Pearson correlation -0.39 $p=0.052$). Most parents were between 35 and 40 (26.5%) or between 40 and 45 years of age (43.5%) and most children were aged 11 years (75%, Table 1). Fourteen percent of the children lived in single parent families. Twenty-four percent of the families reported that the parent with the highest occupational status had a profession for which only elementary or lower level education was required.

Table 1
Description of individual level confounders in the family cohort

Children		
Age	*n*	%
10 years	16	3.0
11 years	403	75.0
>12 years	118	22.0
Unknown	26	
Gender		
Boy	273	49.1
Girl	283	50.9
Unknown	7	
Grade retention (yes)	107	17.2
Family		
Educational status		
Elementary	113	19.6
Lower secondary education	61	10.6
Intermediate vocational education	99	172
Higher secondary or pre-university education	77	13.4
Higher vocational education	131	22.7
University	95	16.5
Occupational status quintiles		
Lowest	116	21.1
Low-intermediate	105	19.1
Intermediate	114	20.8
High-intermediate	106	19.3
Highest	108	19.7
Single parent (yes)	81	13.0
Receiving welfare (yes)	32	5.13

Objective 1: Associations between neighbourhood socio-economic measures and neighbourhood social capital

Fig. 1 shows neighbourhood variation in socio-economic deprivation and ISC. Socio-economic deprivation was not concentrated in the centre of Maastricht and although there were some notable exceptions, high socio-economic deprivation and low levels of ISC tended to cluster together. Table 2 presents means, standard deviations and correlation coefficients of all socio-economic, and social capital variables. Table 3 presents the results from the multilevel regression analyses of socio-economic deprivation and residential instability on the one hand, and measures of social capital on the other. The Pearson correlations in Table 2 as well as the crude βs and the βs controlled for SES, welfare recipient status, age group, gender, and marital status in Table 3 show statistically significant associations between socio-economic deprivation on the one hand and ISC, SC&T and SC&Tc on the other. Thus, higher socio-economic

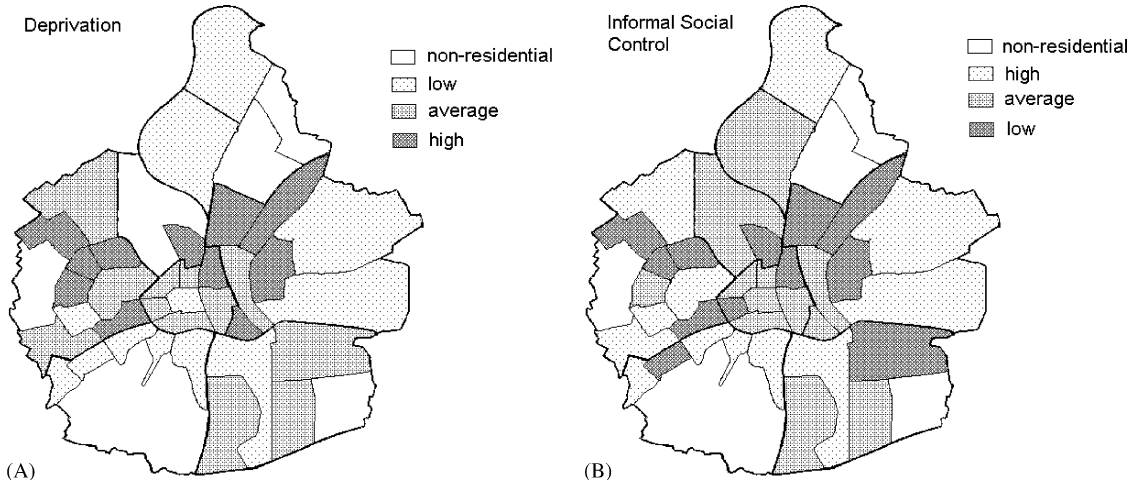

Fig. 1. Neighbourhood variation in socio-economic deprivation and informal social control (ISC).

Table 2
Means, standard deviations and Pearson correlation coefficients of socio-economic and social capital variables

		Descriptives				Pearson correlations			
		n	Mean	SD	Range	Residential instability	ISC	SC&T adults	SC&T children
Socio-economic deprivation	Neighbourhoods	35	0.00	1.00	−1.69–1.68	−0.00	0.65† [a]	0.89†	0.39*
	Individual	3401	−0.06	0.97					
Residential instability	Neighbourhoods	35	0.00	1.00	1.12–4.17	1.00	0.04	0.36*	0.71†
	Individual	3401	−0.09	1.00					
ISC	Neighbourhoods	36	29.10	1.86	24.54–32.79		1.00	0.68†	0.32
	Individual	3401	28.98	1.84					
SC&T adults	Neighbourhoods	36	22.25	3.42	16.71–28.00			1.00	0.61†
	Individual	3401	21.82	3.34					
SC&T children	Neighbourhoods	36	12.30	1.81	9.11–16.36				1.00
	Individual	3401	12.15	1.73					

[a] †: $p<0.001$ **: $p<0.01$ *: $p<0.05$.

deprivation was associated with lower levels of social capital. Furthermore, residential instability was significantly associated with SC&T and SC&Tc: the higher the residential instability, the lower the level of SC&T.

Objective 2: Children's health-related quality of life

In general, general health, mental health, self-esteem, satisfaction, and behaviour were all at a "healthy" level, with means of around 80 (Table 4). Statistically significant, but far from perfect positive correlations were found between all health-related quality of life variables, with Pearson correlations ranging from 0.35 between general health and behaviour to 0.64 between mental health and behaviour.

Children's health-related quality of life and individual-level variables

The middle quintile of family occupational status was associated with general health, albeit statistically imprecise by conventional alpha. Family educational status was associated with general health, mental health,

Table 3
Multilevel regression analysis; the influence of socio-economic deprivation and residential instability on social capital (i.e. ISC, SC&T adults, and SC&T children)

	ISC β (CI[a])	SC&T adults β (CI)	SC&T children β (CI)
(1) Socio-economic deprivation (crude)	1.22 (0.75; 1.70)	3.06 (2.55; 3.58)	0.71 (0.15; 1.27)
(2) Residential instability (crude)	0.08 (−0.54; 0.70)	1.24 (0.18; 2.30)	1.30 (0.87; 1.73)
(3) Final model[b]			
Socio-economic deprivation	1.22 (0.75; 1.69)	3.06 (2.76; 3.37)	0.72 (0.36; 1.08)
Residential instability	0.09 (−0.38; 0.56)	1.24 (0.94; 1.55)	1.31 (0.95; 1.66)
Improvement when including both central variables (cf. confounders[b] only)	$X^2 = 6666.61$ df=2 $p<0.001$	$X^2 = 14328.64$ df=2 $p<0.001$	$X^2 = 7688.81$ df=2 $p<0.001$

[a] CI: 95% confidence interval.
[b] Corrected for occupational status (isei92), educational status, welfare recipient status (yes/no), age group, gender, marital status: single (yes/no).

Table 4
Means, standard deviations and Pearson correlation coefficients of children's general health (gh), mental health (mh), self-esteem (se), satisfaction (sat) and behaviour (bh)

	Descriptives				Pearson correlations			
	N	Mean	SD	Range	mh	se	sat	bh
General health	561	79.3	15.2	21.3–100	0.48†[a]	0.49†	0.49†	0.35†
Mental health (mh)	561	82.5	11.6	23.4–100	1.00	0.61†	0.62†	0.64†
Self-esteem (se)	559	81.1	12.0	28.9–100		1.00	0.94†[b]	0.51†
Satisfaction (sat)	560	79.9	11.1	32.3–100			1.00	0.53†
Behaviour (bh)	562	86.8	9.5	42.9–100				1.00

[a] †: $p<0.001$ **: $p<0.01$ *: $p<0.05$.
[b] This correlation is close to 1 because the satisfaction scale consists of all self-esteem items and some additional satisfaction items.

satisfaction, and behaviour in a non-linear fashion (Table 5).

Single parent family was associated with mental health, self-esteem, satisfaction, and behaviour. In addition, girls reported lower levels of mental health and self-esteem albeit at a statistically imprecise level (Table 5). There was no evidence for an interaction effect between individual-level socio-economic status and neighbourhood-level socio-economic deprivation as specified in the analysis section.

Parental perceived difficulty in child raising was associated with child general health, mental health, self-esteem, satisfaction, and behaviour (data not shown). The child's satisfaction with the relationships with their relatives and the child's satisfaction with the relationship with their parents, were also associated with general health, mental health, and behaviour. Since these two variables were items of the self-esteem and the satisfaction sum scores we did not test for associations with self-esteem and satisfaction.

Contextual effects

After correction for individual confounders, socio-economic deprivation, ISC, and SC&T were significantly associated with general health (Table 6). Furthermore, the results indicated an association between ISC on the one hand and mental health and behaviour on the other, and between SC&T on the one hand and satisfaction on the other. All before-mentioned associations were in the same direction, indicating that children living in 'better'

Table 5
Multilevel regression analysis; the associations of individual level confounders on the one hand and children's general health (gh), mental health (mh), self-esteem (se), satisfaction (sat) and behaviour (bh) on the other

	GH β (CI)[a]	MH β (CI)	SE β (CI)	SAT β (CI)	BH β (CI)
Occupational status					
Lowest (reference)	0	0	0	0	0
Low-intermediate	2.13	0.58	0.11	−1.68	0.39
	(−2.25; 6.51)	(−2.80; 3.97)	(−3.65; 3.42)	(−4.91; 1.56)	(−2.37; 3.15)
Intermediate	3.91	2.59	1.07	0.01	1.65
	(−0.57; 8.39)	(−0.86; 6.04)	(−2.53; 4.67)	(−3.28; 3.31)	(−1.17; 4.46)
High intermediate	4.24	−0.55	−0.90	−1.38	−0.82
	(−0.83; 9.32)	(−4.46; 3.37)	(−5.00; 3.19)	(−5.12; 2.37)	(−4.01; 2.37)
High	3.00	−1.30	−0.73	−1.06	−1.87
	(−2.48; 8.49)	(−5.53; 2.93)	(−5.15; 3.69)	(−5.10; 2.99)	(−5.33; 1.58)
Educational status					
Elementary (reference)	0	0	0	0	0
Lower secondary	5.58	2.53	3.32	4.24	0.84
	(0.41; 10.75)	(−1.47; 6.53)	(−0.87; 7.52)	(0.41; 8.08)	(−2.43; 4.11)
Intermediate vocational	3.30	2.77	3.74	4.31	2.55
	(−1.43; 8.03)	(−0.88; 6.44)	(−0.07; 7.54)	(0.82; 7.79)	(−0.42; 5.53)
Higher secondary	5.26	4.21	3.84	4.59	4.50
	(0.02; 10.5)	(0.18; 8.24)	(−0.38; 8.05)	(0.74; 8.44)	(1.21; 7.79)
Higher vocational	4.58	3.53	2.20	2.84	2.55
	(−0.61; 9.76)	(−0.47; 7.54)	(−1.99; 6.38)	(−0.99; 6.67)	(−0.72; 5.82)
University	7.65	4.40	2.49	2.33	5.35
	(1.70; 13.60)	(−0.19; 8.99)	(−2.26; 7.24)	(−2.03; 6.69)	(1.60; 9.10)
Welfare recipient	−3.08	−0.61	−1.03	−1.65	−1.74
	(−9.37; 3.21)	(−5.48; 4.25)	(−6.10; 4.03)	(−6.29; 2.99)	(−5.73; 2.24)
One parent family	−0.84	−3.74	−3.92	−5.00	−3.31
	(−5.15; 3.47)	(−7.07; −0.40)	(−7.39; −0.45)	(−8.17; −1.82)	(−6.03; −0.60)
Child's gender	−1.64	−1.93	−2.08	−0.60	1.33
	(−4.27; 0.98)	(−3.97; 0.10)	(−4.21; 0.05)	(−2.54; 1.35)	(−0.33; 2.99)
Grade retention	−1.44	−0.64	−2.08	−2.31	1.91
	(−6.72; 3.84)	(−4.68; 3.40)	(−6.29; 2.13)	(−6.17; 1.54)	(−1.39; 5.21)

[a] CI: 95% confidence interval.

neighbourhoods (low in socio-economic deprivation or high in social capital) had a better general health, mental health, behaviour, or satisfaction. No statistically significant associations were found between residential instability and SC&Tc on the one hand and any of the health-related quality of life measures on the other. When the family equivalents of social capital, i.e. parental perceived difficulty in child raising and child's satisfaction with family relationships were entered into the model, all βs changed only by tiny amounts and all statistically significant associations remained unchanged. These variables, therefore, were not further included as confounders in the models.

In order to estimate the effects of the four neighbourhood variables independent of each other, we fitted models with four neighbourhood variables (SC&Tc excepted) entered jointly and with the confounders. All above described effects were no longer evident (Table 6), with the exception of the association between ISC and mental health ($p = 0.002$) and behaviour ($P = 0.08$). However, compared to models containing individual confounders only, all models that included the four neighbourhood variables showed statistically significant improvement (see last row in Table 6).

Discussion

Associations between neighbourhood socio-economic measures and neighbourhood social capital

The results showed that neighbourhoods with higher socio-economic deprivation, generally, had lower levels of informal social control (ISC) and social cohesion and

Table 6
Multilevel regression analysis; the associations of socio-economic deprivation, residential instability and social capital on the one hand and children's general health (gh), mental health (mh), self-esteem (se), satisfaction (sat) and behaviour (bh) on the other

	GH β (CI[b])	MH β (CI)	SE β (CI)	SAT β (CI)	BH β (CI)
a *Models for socio-economic measures and social capital*[a], *both univariate and corrected for individual confounders*					
(1a) Socio-economic deprivation[a] crude	−2.93 (−4.33; −1.52)	−0.96 (−2.10; 0.17)	−0.61 (−1.67; 0.44)	−1.16 (2.13; −0.19)	−0.73 (−1.61; 0.15)
(b) Socio-economic deprivation[a]	−1.82 (−3.59; −0.06)	−0.39 (−1.80; 1.03)	−0.17 (−1.49; 1.15)	−0.70 (−1.97; 0.56)	−0.23 (−1.36; 0.91)
(2a) Residential instability[a] crude	−2.46 (−5.26; 0.35)	−0.69 (−2.75; 1.37)	−0.84 (−2.94; 1.27)	−1.99 (−4.09; 0.10)	−0.34 (−1.97; 1.29)
(b) Residential instability[c]	−2.09 (−4.88; 0.71)	−0.59 (−2.79; 1.62)	−0.53 (−2.86; 1.80)	−1.47 (−3.72; 0.79)	−0.42 (−2.18; 1.34)
(3a) ISC[a,d] crude	−2.45 (−3.93; −0.97)	−1.54 (−2.50; −0.58)	−0.49 (−1.49; 0.51)	−1.01 (−1.93; −0.08)	−0.84 (−1.63; −0.04)
(b) ISC[c]	−1.87 (−3.40; −0.34)	−1.44 (−2.52; −0.37)	−0.23 (−1.36; 0.90)	−0.69 (−1.77; 0.41)	−0.71 (−1.68; 0.27)
(4a) SC&T adults[a,d] crude	−3.09 (−4.44; −1.74)	−1.04 (−2.15; 0.06)	−0.62 (−1.64; 0.40)	−1.35 (−2.28; −0.40)	−0.75 (−1.60; 0.10)
(b) SC&T[c]	−2.06 (−3.75; −0.38)	−0.45 (−1.81; 0.91)	−0.22 (−1.50; 1.06)	−0.96 (−2.18; 0.25)	−0.31 (−1.41; 0.78)
(5a) SC&T children[a,d] crude	−1.85 (−3.38; −0.31)	−0.61 (−1.70; 0.48)	−0.20 (−1.23; 0.83)	−1.13 (−2.08; −0.18)	−0.12 (−1.01; 0.76)
(b) SC&T[c]	−0.98 (−2.56; 0.59)	−0.25 (−1.47; 0.96)	0.34 (−0.82; 1.49)	−0.60 (−1.75; 0.55)	0.20 (−0.80; 1.20)
b *Multivariate model with socio-economic measures and social capital entered jointly*[b]					
Socio-economic deprivation[a]	0.41 (−5.47; 6.29)	−0.09 (−4.36; 4.19)	0.04 (−4.48; 4.57)	1.72 (−2.71; 6.14)	0.50 (−3.11; 4.10)
Residential instability[a]	−1.73 (−5.37; 1.90)	−1.29 (−4.00; 1.42)	−0.65 (−3.66; 2.35)	−0.72 (−3.55; 2.13)	−0.79 (−3.08; 1.50)
ISC[a,c]	−1.58 (−3.71; 0.54)	−2.28 (−3.80; −0.77)	−0.33 (−1.93; 1.27)	−0.47 (−2.06; 1.11)	−1.22 (−2.58; 0.15)
SC&T[a,c]	−0.95 (−7.18; 5.29)	1.46 (−3.10; 6.03)	0.09 (−4.72; 4.89)	−2.06 (−6.75; 2.62)	0.27 (−3.56; 4.11)
Improvement when including all 4 central variables (cf. confounders[b] only)	$X^2 = 141.79$ $p<0.001$	$X^2 = 125.95$ $p<0.001$	$X^2 = 119.84$ $p<0.001$	$X^2 = 121.08$ $p<0.001$	$X^2 = 114.04$ $p<0.001$

[a] Neighbourhoods with higher values are worse of, i.e. more deprived and lower in social capital, respectively.
[b] CI: 95% confidence interval.
[c] Corrected for occupational status (isei92), educational status, family welfare recipient status (yes/no), single parent (yes/no), grade retention, children's gender.
[d] ISC, SC&T adults and SC&T children all standardized (SD=1).

trust in both children (SC&Tc) and adults (SC&T). Residential instability was specifically associated with SC&T and SC&Tc. The results of the present study in a small city in the Netherlands support research conducted in larger American cities. For example, both absolute and relative deprivation were found to be associated with social capital and social disorganisation (Kawachi, Kennedy, & Wilkinson, 1999a). Furthermore,

residentially stable neighbourhoods appeared to be more cohesive and safer than residentially instable neighbourhoods (Aneshensel & Sucoff, 1996). Residential stability, reflected in relatively higher rates of residential tenure and homeownership, has been recognized as a key to both the emergence of social capital and an appreciation of property values (Sampson et al., 1999). Our results indicate that its converse, i.e. residential instability, was specifically associated with both adult SC&T and child SC&Tc. This effect of residential instability is likely to work by "withering" away of the key basis of social capital, a continuity and density in structured relations between individuals who have been living in the same community for an extended period of time (Kawachi & Kennedy, 1997). This insight was important in the theoretical development of the neighbourhood research of the Chicago School. Louis Wirth had emphasized, based on his comparative investigations of Jewish ghetto neighbourhoods in Frankfurt, Germany and Chicago, that the small size and high density of these neighbourhoods explained their strong social cohesion (Wirth, 1928). Half a century later, in a study of London, two later Chicago sociologists, John D. Kasarda and Morris Janowitz, were able to demonstrate that residential stability was indeed more important for explaining social cohesion (Kasarda & Janowitz, 1974; Smith, 1988). However, in the present study, the other dimension of social capital, ISC, was not associated with residential instability. Persons who have just moved into or who are planning to move from a neighbourhood may be equally likely to intervene when children are misbehaving, because of annoyance and personal standards. An explanation of this can also be found in the work of Janowitz on the effect of mass communication on local communities. Media, such as city and community newspapers, can express strong ties that any reader, no matter how long, he or she has lived in the neighbourhood can identify with. Reading the same newspaper can help both newcomers and older residents overcome the alienating tendencies present in the neighbourhood and provide a legitimation for intervening (Janowitz, 1952).

The strong association between objective aggregated measures and subjective reports by residents, adjusted for individual-level characteristics, that we have found in Maastricht is important, as it demonstrates that certain collective characteristics of European neighbourhood residents do have an impact on the perceived social climate as has been the case in American cities (Aneshensel & Sucoff, 1996; Sampson et al., 1999). This finding thus contributes to the general accumulating international evidence of the validity of social ecological research into contextual effects on determining individual and public health outcomes (Susser, 1994a, b), and our findings suggest that correlated measures of socio-economic deprivation may contribute to the level of ISC and SC&T in neighbourhoods, while residential stability may more specifically contribute to SC&T.

Associations of contextual variables with children's health-related quality of life

When models were fitted with four neighbourhood variables, all effects of these variables on children's health-related quality of life seemed to disappear, except for the associations between ISC and mental health and behaviour. That most effects disappeared was the result of the high correlations between these neighbourhood variables and does not indicate that the effects do not exist, but rather that the model cannot reveal which neighbourhood variable is most important. The conclusion that is warranted in interpreting the model is that all socio-economic and social capital variables are equally important in influencing Maastricht children's health-related quality of life. The modelling of the complex relationships investigated in this study must proceed by incorporating only one neighbourhood variable at a time when estimating their effects.

The models that included one variable at a time indicated associations between socio-economic deprivation, ISC and SC&T on the one hand and children's general health on the other, and an association between SC&T and children's satisfaction. Although these associations were the only ones that were statistically significant, the direction and the effect sizes of residential instability were also rather similar. Therefore, rather than maintaining that the association between, for example, ISC and general health is entirely specific, the more correct interpretation would be that all neighbourhood variables indicating more socio-economic deprivation and less social capital predict poorer general health status and satisfaction status in children. However, whereas general health was associated with all neighbourhood variables, mental health and behaviour were specifically associated with ISC and these associations remained statistically significant after correction for possible family equivalents of social capital. Because ISC was associated with both general health and mental health and because the latter two outcomes were highly correlated, we examined post-hoc whether the association between ISC and mental health would remain after adjustment for general health. After addition of general health as an extra confounder in the model, the association between ISC and mental health was reduced but remained with a β equalling nearly 1 standard deviation ($\beta = -0.87$), albeit statistically imprecise by conventional alpha ($p = 0.073$). Thus, our findings suggest that children may require higher levels of ISC for a more healthy psychological development, whether they live in a deprived area or not, to a large degree independent of their general health. However, these

findings might only be valid for schools with a high response rate (see methodological issues below).

SC&Tc did not have an effect on any of the outcomes, but was based on smaller numbers of respondents per neighbourhood, and reproducibility was lower (see methodological issues below).

The results of the present study are in line with previous research in general populations. Ecological studies, without individual data, have reported associations between socio-economic deprivation and chronic illnesses (Fowle & Stewart Brown, 1994), and between socio-economic deprivation and suicide (Whitley, Gunnell, Dorling, & Smith, 1999). More importantly, multilevel studies have reported associations between both individual socio-economic status and neighbourhood socio-economic deprivation on the one hand and life stress in adolescents (Allison et al., 1999), problem behaviour in children and adolescents (Brooks-Gunn, Duncan, Klebanov, & Sealand, 1993; Kalff et al., 2001), mental illnesses in children (Rutter, 1981), coronary heart disease (CHD) in adults, risk factors for CHD (Diez Roux et al., 2001; Diez Roux et al., 1997), premature mortality, (Bosma, Van de Mheen, Borsboom, & Mackenbach, 2001), mental health service use (Croudace, Kayne, Jones, & Harrison, 2000; Driessen et al., 1998), and incidence of psychosis (Croudace et al., 2000; Van Os et al., 2000) on the other hand. Only some studies reported that socio-economic deprivation effects on mortality and mental health respectively were mostly attributable to individual level SES (Reijneveld & Schene, 1998; Sloggett & Joshi, 1994).

Furthermore, low social capital has also been reported to be associated with poor perceived health in adults (Kawachi, Kennedy, & Glass, 1999) and low social cohesion has been found to specifically be associated with depression in adolescents, and tentatively with anxiety and defiant behaviour, but not to conduct disorder (Aneshensel & Sucoff, 1996).

However, we did not find any associations between residential instability and quality of life, although we expected to (Shaw & McKay, 1969; Smith, 1988).

Mechanisms

Epidemiological surveys provide little information on the mechanisms that may mediate and moderate associations between contextual variables and individual health outcomes. Several possible explanations have been given for the associations between deprived areas and higher incidences of mental health problems (Kawachi et al., 1999b; Reijneveld & Schene, 1998; Rutter, 1981). Social factors, physical aspects and poor provision of services in deprived areas may cause and/or aggravate health problems, and/or there is selective migration or retention of persons with health problems in deprived areas.

Because our findings suggest a non-specific effect of all neighbourhood variables on general health and a specific effect of ISC on mental health, different underlying mechanisms that constitute distinct pathways to mental health and general health outcomes may exist. For example, if neighbours correct deviant behaviour in an early stage of childhood development (i.e. exert ISC), this collective intervention may directly prevent the children from behaving badly as well as indirectly provide them with self-confidence and a sense of protection. This community-based cognitive sense of security may well be strong enough in children at the susceptible age of our sample to off-balance nascent emotional problems that have developed in response to a deprived environment. This mechanism has been described by Talcott Parsons in his general theory of social control (Parsons, 1951). In this theory, the first element of social control is a specific kind of social support given to the child by informal or formal individual or collective control agents whose primary significance is to give reassurance in situations of strain and anxiety. As Parsons notes (p. 299): 'In one sense the consequence of support is to localize the focus of strain, by making it possible for ego to feel that insecurity is not "total" but can be focused on a limited problem area for adjustment.' The weakening of the informal social control function in neighbours will have the consequence of interfering with this anxiety localization process causing aggressive and/or defensive reactions and decreased feelings of well-being in the child. This mechanism has been empirically confirmed in studies of deprived neighbourhoods in the United States. The fact of having more low income neighbours seems to predict higher levels of externalising problem behaviours among five-year-olds controlling for family income, poverty status, and other family variables (Duncan et al., 1994). Interpretation of these results have suggested that the informal social control agents in deprived neighbourhoods may show a tendency not to correct aggressive and acting out behaviour in children because of feelings that children must be able to defend themselves through such behaviours (McLoyd, 1998). At the other end of the life course, studies of the mental functioning and well-being of elderly persons have also demonstrated the converse; that an increase in informal support is related to fewer symptoms of psychological distress and higher levels of well-being (Krause, Liang, & Keith, 1990; Stevens, Kaplan, Ponds, & Jolles, 2001). Most likely a multiple-influence transaction model is needed to explain the specific pathway whereby ISC as a specific type of community agency, functions to modulate individual temperamental problems in deprived social environments to prevent mental health problems (DeVries, 1994).

Other pathways may be responsible for the associations between all socio-economic deprivation and social

capital variables on the one hand and general health and satisfaction on the other. Firstly, both a more rapid diffusion of health information and the increased likelihood that healthy norms and behaviour are adopted might mediate these associations (Kawachi et al., 1999b). Secondly, these associations could be caused by psychological processes, related to not only bonds within the family but also to bonds within the neighbourhood that contribute to affective support and self-esteem, which may improve general health (Kawachi et al., 1999b). The present results, however, did not reveal an association between neighbourhood variables and self-esteem. Thirdly, deprived neighbourhoods usually are located in areas with environmental problems and pollution. For example, three Maastricht deprived neighbourhoods are located near an area with factories and industry; two others are located near the highway or near the railway. These five neighbourhoods were also low in social capital. The environmental pollution in these neighbourhoods could be responsible for the non-specific effect on general health. Finally, previous literature described the lack of resources in socio-economically deprived neighbourhoods, which may be responsible for lower levels of health and quality of life (Aneshensel & Sucoff, 1996; Duncan et al., 1994; Garcia Coll et al., 1996; Kawachi et al., 1999; Ormel, Lindenberg, Steverink, & Vonkorff, 1997; Ross, Mirowsky, & Pribesh, 2001).

All these above-mentioned pathways are especially important in adolescence, an age of increasing independence and autonomy, with increasing amounts of time spent in neighbourhood settings, away from the family and the formal social control institution of the school (Allison et al., 1999). Therefore, these mechanisms have the potential of interfering in the somatic and psychological development of adolescents (Kalff et al., 2001; Lewis, David, Andreasson, & Allebeck, 1992; Van Os, 2000).

With specific reference to our finding of the association of residential instability and children SC&Tc, future research in Europe should focus upon the maintenance and breakdown of "institutional completeness" of neighbourhoods. Institutional completeness refers to the weakening of community institutions such as extended families, ethnic businesses, church and school organisations through processes of in and out migration and persistent poverty. Indigenous structures promoting social capital such as multigenerational linked peer groups associated with these institutions erode and disappear and a situation of concentrated disadvantage emerges (Sampson et al., 1999). Breakdown of institutional completeness has been shown to result in more social and public health problems in studies of American neighbourhoods with high concentrations of Japanese and Mexican American migrants (Tsukashima, 1985; Valdez, 1993). Attention to processes such as maintenance of institutional completeness may provide a more sensitive appreciation of the dynamics involved with social capital and child and adolescent mental health.

Individual-level variables

Although the categories of occupational status did not show statistical significance, the βs were generally in the expected direction, and, more importantly, the improvements when adding the variable were statistically significant in all outcome measures (data not shown). That some of the βs of the categories showed no association or even a negative association is probably due to collinearity with educational status, for which associations with the outcome variables were much stronger. However, inclusion of the combination of occupational status and educational status was necessary to control for individual-level confounding, because this combination is considered to be the best individual level equivalent of neighbourhood socio-economic deprivation in the Netherlands (Van Berkel-Van Schaik & Tax, 1990).

In order to ensure that the effect of neighbourhood ISC and other neighbourhood variables was not confounded by family control, parent–child interaction variables were included as extra confounders. As expected, parental perceived difficulty in child raising and child's satisfaction with parents and child's satisfaction with relatives were associated with all outcomes. However, when we included these family equivalents of social capital, βs remained similar. To our knowledge, this is the first study showing that the effects of neighbourhood variables are not confounded by family control.

Although we included occupational status and educational status, and all other individual and family variables that we hypothesized to possibly confound the associations with quality of life, the possibility remains that residual confounding may have lead to spurious results at the neighbourhood level. We did not, however, have other hypotheses of confounding.

Other methodological issues

A principle objective of our methodology was to examine effects of neighbourhood variables that were obtained independently of the family sample respondents' answers. This was analytically critical because these variables describe whole neighbourhoods rather than the group of respondents of the family sample.

Nevertheless, the present study design has several limitations. Firstly, the response rate in the community survey was only 48%, and the response rate in neighbourhoods with higher socio-economic deprivation scores was even lower. However, the community sample

respondents and the general population between 20 and 65 years of age do have similar distributions in age, gender and ethnicity. Furthermore, all respondents were considered to be "key" informants about their own neighbourhood, with the implicit assumption that responders gave the same information about the neighbourhood as the non-responders would have given. The validity of the sample might have been judged differently if the principle objective was to obtain information on the person, not his or her neighbourhood. Thus, this information is more or less independent of the response rate, even if it were as low as it was in the neighbourhood with the lowest response. In order to verify this assumption, we examined post-hoc associations between ISC and SC&T collected in the family sample, and those collected in the community survey (reproducibility). Neighbourhood scores on ISC and SC&T based on these questionnaires were highly correlated, although SC&Tc scores were not.

Secondly, most individuals perceive their neighbourhood as comprising their own street and perhaps one or two side streets (perceived neighbourhoods). The neighbourhoods defined in the present study were much larger. Clustering these neighbourhoods means that information about the shared environments of the perceived neighbourhoods is lost. However, empty multilevel models with the individual answers on the ISC and the SC&T scales revealed not only variance at the individual level, but also at the neighbourhood level, indicating that the answers were grouped within the neighbourhoods or in other words that neighbourhoods differ from each other. Furthermore, when all analyses on the family data were repeated for homogeneous neighbourhoods only, the βs were similar or even stronger, and most of the statistical significance remained, even though the power of the analyses was much lower.

Thirdly, the response rate of the family cohort varied considerably per school. Therefore, separate sensitivity analyses were performed for schools with a response rate above 50% and schools with a response rate below 50%. Most statistically significant associations were in the same direction for both high and low responding schools, except for the associations between ISC on the one hand and mental health and behaviour on the other in low responding schools. These associations were close to 0 in the schools with low response rates. We may conclude that although it is not sure whether the association between ISC and mental health and behaviour is valid for low responding schools, it is valid for high responding schools. Otherwise, we feel that it is very unlikely that non-response would have resulted in spurious results. Furthermore, the intra class correlations (ρ) were low in even the empty models (intercept only). However, the neighbourhood variance (σ^2_μ) was statistically significant for most of the outcome variables, indicating that neighbourhoods do matter. This supports the rationale for studying neighbourhood effects in all outcome variables.

Finally, socio-economic indicators and social capital were highly correlated in our study. Therefore, it was not possible to estimate the independent effects of all neighbourhood variables. Future studies investigating the independent effect of objective and subjective neighbourhood variables, should over sample low socio-economic deprivation and low social capital neighbourhoods and high socio-economic deprivation and high social capital neighbourhoods in order to unravel the effects of socio-economic deprivation and social capital. As can be seen in Fig. 1, this is possible, as there are some neighbourhoods high in ISC and high in socio-economic deprivation and some low in ISC and low in socio-economic deprivation. This future methodological strategy also should have some important theoretical advantages in understanding not only the dynamics of neighbourhoods with concentrated disadvantage, but also the protective effects of concentrated affluence (Sampson et al., 1999).

Similar types of persons tend to cluster in the same neighbourhood (social selection). This means that neighbourhood effects are not related to the geography of the neighbourhood itself but to the people actually living there. Whether the outcomes are the result of differences between neighbourhood characteristics (causation theory) or because different types of families choose to live in different neighbourhoods (selection theory) is beyond the scope of the present paper.

Conclusion

Both socio-economic deprivation and social capital were associated with various quality of life dimensions, whereas the mental health and behaviour dimensions were more specifically associated with one aspect of social capital: ISC. The wider social environment may impact on the emotional and physical development of young people through different pathways.

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Appendix A. Translation of the Dutch ISC and SC&T items

A.1. ISC: What is the likelihood that your neighbours can be counted on to intervene in the following situations: (very likely, likely, neither likely nor unlikely, unlikely, very unlikely)

a. If neighbours throw out garbage on the street (added item)
b. If one of the houses constantly gives noise pollution (added item)
c. If children were skipping school and hanging out on the street corner (original item)
d. If children get into mischief, are being naughty (added item)
e. If children were spray-painting graffiti on a local building? (original item)
f. If children were showing disrespect to an adult? (original item)
g. If children were showing disrespect to an elderly person (added item)
h. If a fight broke out in front of their house? (original item)
i. If the fire station closest to their home was threatened with budget cuts (in Dutch not the fire station but the ambulance)
j. If someone is planning to open a sex club (added item)

A.2. SC&T

How strongly do you agree or disagree with the following statements? (a five point Likert scale from strongly agree to strongly disagree)

a. People are willing to help their neighbours (original item)
b. This is a close-knit neighbourhood (original item)
c. People in this neighbourhood can be trusted (original item)
d. People in this neighbourhood generally don't get along with each other (original item)
e. People in this neighbourhood do not share the same values (original item)
f. Children in this neighbourhood are close-knit
g. Children in this neighbourhood are heading for trouble
h. Children in this neighbourhood play together a lot
i. This neighbourhood is unsafe for children (traffic)
j. I don't send my children to the neighbourhood school
k. There are many children in this neighbourhood which I don't want my child to play with

Next items only for respondents with children

l. My child has a lot of friends in this neighbourhood
m. My child has a lot of friends at school
n. Children at school are close-knit
o. Children at school are heading for trouble
p. Children at school play together a lot
q. The school is unsafe for children (traffic)

SC&T adults: items a–h, j, and k
SC&T children: items f, h, l–n, and p

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3.2 Social capital and children's perceived health in different sociocultural settings

We conducted a cross-national study to examine the association between neighbourhood socioeconomic deprivation, social capital and child health in two countries and multiple ethnic groups. For our analysis we used data from 1) the Project on Human Development in Chicago Neighborhoods (PHDCN), USA and 2) the Maastricht Quality of Life study (MQoL), the Netherlands. Both the PHDCN and the MQoL collected data on objective neighbourhood socioeconomic deprivation, subjective neighbourhood social capital (i.e. informal social control, social cohesion and trust), and children's perceived health. Multilevel analyses were conducted using both neighbourhood level and individual level data.
Lower socioeconomic deprivation scores, and higher levels of informal social control as well as social cohesion and trust were associated with higher levels of children's perceived health, in both Maastricht and the Chicago Hispanic subsample, but not in the Chicago non-Hispanic samples. The results suggest that associations between the wider social environment and health outcomes vary across different populations and cross-national contexts.

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Social capital and children's perceived health in different sociocultural settings

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Abstract

We conducted a cross-national study to examine the association between neighbourhood socioeconomic deprivation, social capital and child health in two countries and multiple ethnic groups. For our analysis we used data from 1) the Project on Human Development in Chicago Neighborhoods (PHDCN), USA and 2) the Maastricht Quality of Life study (MQoL), the Netherlands. Both the PHDCN and the MQoL collected data on objective neighbourhood socioeconomic deprivation, subjective neighbourhood social capital (i.e. informal social control, social cohesion and trust), and children's perceived health. Multilevel analyses were conducted using both neighbourhood level and individual level data.

Lower socioeconomic deprivation scores, and higher levels of informal social control as well as social cohesion and trust were associated with higher levels of children's perceived health, in both Maastricht and the Chicago Hispanic subsample, but not in the Chicago non-Hispanic samples. The results suggest that the impact of the wider social environment on health outcomes varies across different populations and cross-national contexts.

Keywords Social Capital, Socioeconomic Deprivation, Children, Perceived Health, Cross-Cultural Differences, Ethnicity

Introduction

The rates of illness in a community depend not only on the vulnerabilities of individuals but also on the environment in which they find themselves. However, in economically developed countries it is still unclear which aspects of the environment have the greatest effects on health (Sloggett and Joshi, 1994, Lynch et al., 2000), or how these effects might be mediated (Yen and Syme, 1999). There is growing interest in the social environment as a cause for variations in health both in adults (Bosma et al., 2001, Diez Roux et al., 2001, Kawachi et al., 1999a) and in children and adolescents (Aneshensel and Sucoff, 1996, Leventhal and Brooks Gunn, 2000, Kalff et al., 2001, Brooks-Gunn et al., 1993). This has led to the premise that social and organisational characteristics of areas explain, at least in part, differences in morbidity and mortality.

Social capital

Social capital is a concept which attempts to describe the quality and quantity of social interactions in a community. It has been “defined” as "those features of social organisations - such as networks of secondary associations, high levels of interpersonal trust and norms of mutual aid and reciprocity - which act as resources for individuals and facilitate collective action" (Kawachi et al., 1997b). Social capital has increasingly been investigated as a possible explanation for differences in health that are found between places, or between groups of people (Amick et al., 1995, Wallace and Wallace, 1997, Kawachi et al., 1999b). There is an accompanying literature reporting associations between social capital and health and other social factors that may affect health and health related problems such as violence (Drukker et al., 2003, Kawachi et al., 1997a, Sampson et al., 1997, Veenstra, 2002).

A variety of definitions and measures of social capital exist (Coleman, 1988, Bourdieu, 1986, Portes and Sensenbrenner, 1993, Portes, 1998, Lochner et al., 1999). The literature suggests four main overlapping theoretical strands: collective efficacy, social trust /reciprocity, participation in voluntary organisations, and social integration for mutual benefit (McKenzie et al., 2002). Many of these overlap and are inter-related.

Collective efficacy has emerged as a useful element of social capital. It describes the process by which the agents of action and expectation of action in a neighbourhood collectively transform, and socially organise, potential network structural resources into desired outcomes (Sampson et al., 1999, Emirbayer and Goodwin, 1994, Portes, 1998). Sampson et al measured its two facets (informal social control, and social cohesion and trust) by aggregating respondents’ answers to questions concerning their perception of their neighbourhood

(Sampson et al., 1997). So measured, collective efficacy has been found to be a sensitive predictor of neighbourhood violence and health outcomes for children (Sampson et al., 1997, Morenoff, 1999).

But why should neighbourhood-level measures of informal social control (ISC) and social cohesion and trust (SC&T) be associated with individual-level health? One hypothesis is that areas with higher levels of ISC and SC&T develop social environments with fewer risks. Another hypothesis is that facilitative behaviour of residents produces social supports and safety nets, which buffer the effects of life events on health. Yet another hypothesis is that neighbourhoods high in collective efficacy are better able to acquire (or not to lose) educational, clinical and housing resources that are linked to health. Kawachi and Berkman (Kawachi and Berkman, 2001) developed a "main effect model", whereby participation in social networks results in exposure to social influence (norms), positive affective states, and beneficial neuroendocrine responses. McKenzie (Cullen and Whiteford, 2001) points to the links between levels of social capital, hostile environments, adaptive behavioural change in individuals and groups of individuals and the effects of neuroendocrine stress pathways on the immune and cardiovascular system.

Sampson et al (Sampson et al., 1997) argue that collective efficacy does not exist in a vacuum. They point to its relationship to structural contexts and the political economy such as patterns of economic stratification by race and place that produce concentrated disadvantage. They argue; "…that alienation, exploitation and dependency wrought by resource deprivation acts as a centrifugal force that stymies collective efficacy". In support of this, Drukker et al have demonstrated that collective efficacy is strongly associated with neighbourhood socioeconomic deprivation (Drukker et al., 2003). Hence the structure of society and its political economy could affect the development of collective efficacy in an area.

In addition, such extra-community factors may have an important influence on the association between collective efficacy and health outcomes. This may be through the direct influence of neighbourhood socioeconomic deprivation and health (Bosma et al., 2001, Diez Roux et al., 2001, Kalff et al., 2001) or by their effects on collective efficacy. For instance, the ability of a community to fight the closure of a health centre in their neighbourhood may reflect in part their internal organisation but also their links to structures in society with the power to keep the health centre open. Access to power structures may be different for different economic or racial groups within a country.

Sociocultural differences

Though there has been some investigation of the interrelations between social capital variables and socioeconomic variables, little is known about variations in social capital or their associations with health in different sociocultural contexts within a country or between countries (Harpham et al., 2002). If we accept that the concept of collective efficacy is applicable in different developed countries, differences in societal structure, culture and access to power on a country by country basis may be expected to have an influence on both the development of collective efficacy and its impact. In addition, it is not fully known to what degree associations between collective efficacy and health are independent of variation in neighbourhood socioeconomic deprivation across different sociocultural settings.

Therefore, our analytical strategy involved the use of cross-national research methodology to test hypotheses that are reasoned to be applicable to all developed industrialised societies (Kohn et al., 1990b). The nation provides the context of analysis from which the generality and variability of findings can be established (Kohn, 1987). Choosing a small number of nations increases the theoretical leverage of findings in diverse contexts. Our aim was not simply to replicate findings in one country with those of another, but to improve and enlarge the scope of social capital theory and measurement through cross-national research (Miller et al., 1981). Therefore, the present study included Chicago (Illinois, United States) and Maastricht (The Netherlands) as two study sites.

Chicago is a multi-ethnic city; Maastricht is smaller and ethnically much more homogeneous. Differences in individual income, and consequently differences in neighbourhood socioeconomic deprivation, are much smaller in Maastricht than in Chicago, because of the relatively strong national safety net of social and health services in the Netherlands (Kleinhans et al., 2001, Thompson, 2000) which, therefore, represents many European welfare state societies. On the other hand, Chicago has considerable socioeconomic, ethnic and cultural diversity, resulting in the tendency that persons of the same ethnicity cluster together in the same neighbourhood (segregation) (Buka et al., 2003). Previous research in Chicago showed differences in collective efficacy between Chicago ethnic groups (Sampson et al., 1997, Earls, 2001). Therefore, we were sensitive to the possibility of interactions with ethnicity in constructing our analytical models.

Adolescents

Investigation of possible influences of social capital on health may be more important in adolescents than in adults because previous work has suggested that ecological variables may

have effects throughout a course of a life by impacting on the somatic and psychological development of young people (Kalff et al., 2001, Lewis et al., 1992, Van Os, 2000). In addition, adolescence is a time during which children become increasingly independent and autonomous, and spend more time in neighbourhood settings away from family and school (Allison et al., 1999). We, therefore, reasoned that neighbourhood factors would be an important exposure in this group.

Aim of the study

We studied whether levels of collective efficacy in cities in different sociocultural settings or in different racial groups within a city vary and whether their associations with children's health also differ. We tested our hypotheses by comparing the influence of social capital and neighbourhood socioeconomic deprivation on adolescent health in Chicago, Illinois (Project of Human Development in Chicago Neighbourhoods, hereafter PHDCN (Sampson et al., 1997)) and Maastricht, the Netherlands (Maastricht Quality of Life Study, hereafter MQoL (Drukker et al., 2003)). The two cities represent general differences in national context between the United States and the Netherlands. The same measure of social capital (collective efficacy) in studies of children's health have been applied in both cities in parallel studies. Comparing directly the results on several general hypotheses in a cross-national study will aid in extending the power and scope of interpretations developed from social capital theory.

Methods

Chicago is one of the largest cities of the United States with a population of around 3 million. Non-Hispanic White Americans, African Americans, and Hispanic Americans each represent approximately a third of the population (Sampson et al., 1997). The Chicago Hispanic population is predominantly of Mexican American origin (Cervantes, 1996).

For the PHDCN, 874 census tracts were combined to create 343 "neighbourhood clusters" (NCs) consisting of approximately 8000 inhabitants each. NCs are smaller than the 77 established community areas in Chicago but it is argued that they are large enough to approximate local neighbourhoods. They are of similar size to an electoral ward (10 000 people), which is often used as the unit of study in UK social epidemiology. NCs were composed of geographically contiguous census tracts, and were internally homogeneous on key census indicators. Geographic boundaries and knowledge of Chicago neighbourhoods

guided the creation of the NCs (Sampson et al., 1997). NC socioeconomic status and NC racial/ethnic mix were constructed using 1990 US census data. Socioeconomic status was defined using NC-level indicators of poverty, public assistance, income, and education. A probability sample stratified by socioeconomic status (trichotomised in equal thirds) and racial/ethnic mix (7 strata: ≥ 75% African Americans, ≥ 75% White, ≥ 75% Latino, ≥ 20% Latino and ≥ 20% White, ≥ 20% Latino and ≥ 20% African Americans, ≥ 20% African Americans and ≥ 20% White, NCs not classified) of 80 NCs was drawn, for the baseline measurements of the PHDCN family cohort (Sampson et al., 1997, Sampson, 1997). The 21 strata show racial and ethnic segregation, but also show that minority neighbourhoods in the United States are not always homogeneous (Sampson et al., 1997). Within each sampled neighbourhood a clustered random sample of households was screened and all families with children in pre-specified age cohorts were selected for participation (Kuo et al., 2000).

Maastricht is a small city (population 122 000) in the south of the Netherlands, with a relatively homogeneous population (CBS (Statistics Netherlands), 2003). Twenty percent of the population have a non-Dutch nationality; six percent a non-European. Local authorities all over the Netherlands have defined neighbourhoods, and the boundaries of these neighbourhoods follow main roads and, therefore, may be considered ecologically meaningful (CBS (Statistics Netherlands), 1996). These neighbourhood definitions are widely used by local authorities and researchers, and the Statistics Netherlands (CBS) supplies a variety of characteristics on these neighbourhoods (CBS (Statistics Netherlands), 2003). Maastricht consists of 36 residential neighbourhoods, housing between 300 and 8500 inhabitants, and all these neighbourhoods were selected for the MQoL (Drukker et al., 2003).

Both the PHDCN and the MQoL consisted of a family cohort study as well as a community survey. The family cohort studies assessed health and other individual and family characteristics in samples of families, and the community surveys measured social capital in random community samples. The PHDCN researchers collected their data through face-to-face interviews, whereas the MQoL researchers used self-administered questionnaires. The present paper uses individual and family baseline data from the family studies and social capital from the community surveys aggregated to the neighbourhood level. The baseline measurement of the family cohort and the community survey of the PHDCN were in 1995, the MQoL collected these data in 2000.

Children's Perceived Health

The PHDCN family study collected data from different age cohorts. For the present comparison study, the age 12 cohort of children was used; children were interviewed within 6 months of their 12th birthday at baseline (mean 12 years). All Maastricht children attending one level of the Dutch educational system were selected for the MQoL family cohort; most of them were aged 11 years (mean 11 years). Children's perceived health was measured by asking one question: "How do you perceive your health?", in both studies. Children could answer on a 5-item Likert type scale: 1 excellent, 2 very good, 3 good, 4 fair, or 5 poor. Perceived health is a simple, yet widely used measure and it has been shown to be a reliable predictor of mortality and health care use in adults (Idler and Benyamini, 1997, Fylkesnes, 1993, Lundberg and Manderbacka, 1996). While less is known about the validity of child self-reports of health status, unpublished analysis of MQoL data showed significant correlations between objective measures of child height and weight and child-reported health status.

Neighbourhood Social Capital

Social capital was measured in both community surveys using two scales: informal social control (hereafter: ISC) and social cohesion and trust (hereafter: SC&T), developed by Sampson and colleagues (collective efficacy) (Sampson, 1997). These scales consist of 5 items each and respondents could answer these on a 5-point Likert scale (Sampson, 1997). The ISC scale measures the respondents' perception of their neighbourhood. This is done by asking whether they think their neighbours would be willing to intervene in hypothetical situations; for example if children are skipping school or fighting with each other (see table 1). The SC&T scale uses similar methods to measure bonds and trust among the residents of the neighbourhoods (see table 1). For the purpose of the MQoL both scales were translated into Dutch and back translated into English, and final differences were resolved by consensus. Sum scores were constructed of both scales, and these individual sum scores were aggregated to construct the neighbourhood level social capital variables. In the present analyses, ISC and SC&T scores were recoded so that higher scores indicated higher levels of informal social control and social cohesion and trust, respectively.

Neighbourhood Socioeconomic Deprivation

Neighbourhood socioeconomic deprivation was estimated using data of the 1990 Chicago decennial census, Maastricht local authorities, and Statistics Netherlands (CBS). Maastricht data were obtained from the years 1996 to 1999, except for income figures (1996). Factor

Table 1: Informal social control, and social cohesion and trust scales

Informal social control (ISC) items

What is the likelihood that your neighbours can be counted on to intervene in the following situations: (very likely, likely, neither likely nor unlikely, unlikely, very unlikely)

If children were skipping school and hanging out on the street corner

If children were spray-painting graffiti on a local building?

If children were showing disrespect to an adult?

If a fight broke out in front of their house?

If the fire station closest to their home was threatened with budget cuts (in Dutch not the fire station but the ambulance)

Social Cohesion and Trust (SC&T) items

How strongly do you agree or disagree with the following statements? (a five point Likert scale from strongly agree to strongly disagree)

People are willing to help their neighbours

This is a close-knit neighbourhood

People in this neighbourhood can be trusted

People in this neighbourhood generally don't get along with each other

People in this neighbourhood do not share the same values

analyses were conducted to reduce these data into a lesser number of underlying constructs. Socioeconomic deprivation (concentrated disadvantage) was the most important underlying construct, both in the Maastricht and in the Chicago factor analyses. Regression factor scores were calculated for both cities, yielding continuous variables with mean 0 and unity standard deviation, higher scores indicating more socioeconomic deprivation. The Chicago neighbourhood socioeconomic deprivation variable was constructed as in earlier published studies using proportion below poverty line, receipt of public assistance, female headed families, proportion unemployed, density of children (<18 years), and proportion of black residents (Sampson et al., 1997). The Maastricht neighbourhood socioeconomic deprivation variable was constructed as in earlier published studies using indicators of the proportion single parent families, non-Dutch nationality, proportion non-voters, school absenteeism rate, proportion receiving unemployment benefit, proportion receiving social welfare benefit, mean income, proportion high incomes, proportion low incomes, and proportion economically inactives (Drukker et al., 2003). Although the individual indicators are not identical, the factor

analysis gave us confidence that they were all representatives of a common underlying conceptual construct we have termed socioeconomic deprivation.

Individual-level Confounders in the Family Studies

Family socioeconomic status (family SES) and welfare recipient status were considered to be the individual level equivalents of neighbourhood socioeconomic deprivation, and therefore were hypothesised to be confounders. Family SES in both Chicago and Maastricht was estimated using occupational status, and was collapsed into 5 categories, which were entered as indicator variables in the equation, with the lowest category being the reference category.

Single parent family, child's gender, age, and ethnicity were also hypothesised to be associated with both the neighbourhood variables and perceived health. Gender was considered important because the hazards and illnesses that young boys and young girls suffer are different and they answer questions on health differently. Furthermore, the MQoL data concerned children attending the same level of the Dutch educational system. Therefore, grade retention (i.e. whether or not children repeated a grade), led to the variable age in the Maastricht data. Grade retention was also added to the models with the PHDCN data in order to increase similarity between analyses of the two data sets.

In addition, the parents of the PHDCN cohort were asked two questions on ethnicity: 1) "Are you Latino or Hispanic?" and then 2) "If you were asked to put yourself into only one of these groups, in which one would you place yourself?" (Asian, Pacific Islander, African American / Black, Caucasian / White, Native American, other). This followed the approach of the U.S. Census. These two variables were combined to classify subjects using "Latino precedent" logic. So, any reporting yes to question 1 were classified as Hispanic. Those that said no were then classified as white, black, or “other” accordingly. The resulting ethnicity variable was used to study hypothesised interaction effects of ethnic group by the neighbourhood variables. The MQoL included one question on ethnicity, answers were recoded into Dutch and non-Dutch.

Statistical Analysis

All analyses were performed using STATA (version 7) (StataCorp., 2001). First, ISC and SC&T replies of the respondents of the community surveys and the aggregated ISC and SC&T answers per neighbourhood were explored and Pearson correlations between ISC, SC&T and socioeconomic deprivation were calculated, using both Chicago and Maastricht

data. In addition, the Chicago data were stratified by individual-level ethnicity or neighbourhood ethnic composition.

Second, our structured data were addressed by means of multilevel regression analysis (Snijders and Bosker, 1999) to investigate the neighbourhood effects while controlling for possible individual-level confounders. Multilevel or hierarchical linear modelling techniques are a variant of the more often used unilevel linear analyses and are ideally suited for the analysis of clustered data of this type. Data grouped according to the neighbourhood are, in statistical terms, part of a multilevel structure with level-one units (individuals) clustered into level-two units (neighbourhoods). The βs are the fixed regression coefficients of the predictors in the multilevel model and can be interpreted identically to estimates in unilevel linear regression analyses (i.e. the change in the response variable with one unit change in the exposure variable).

In order to estimate differences in social capital between Chicago and Maastricht, the data sets of the community surveys of both cities were combined and city (Chicago, Maastricht) and individual level variables (income, unemployment, age group: 20-34, 35-54, 55-70, 71+, gender, and ethnicity) were entered in a multilevel model, resulting in the following model:

$$\text{Social capital}_j = \beta_0 + \beta_1\ \text{city}_j + \beta_{2\text{-}5}\ \text{income category (1-4)}_{ij} + \beta_6\ \text{unemployment}_{ij} + \beta_{7\text{-}9}\ \text{age group(1-3)}_{ij}, + \beta_{10}\ \text{gender}_{ij} + \beta_{11\text{-}13}\ \text{ethnicity indicator (1-3)}_{ij} + \mu_j + \varepsilon_{ij}$$

In which the social capital variable was either ISC or SC&T.

Third, socioeconomic deprivation, ISC and SC&T were considered to be the main exposure variables and children's perceived health, measured in the family cohort studies, was included as the response variable, which was analysed as a continuous variable. Four sets of multilevel models, used to model children's perceived health in relation to the neighbourhood measures, were run. First, crude analyses were done with one neighbourhood variable at a time. Second, individual-level variables only were entered in the model. Third, one neighbourhood variable at a time was controlled for family SES, family welfare recipient, single parent family, child's gender, grade retention, age, and ethnicity. This resulted in the following multilevel model:

$$\text{Children's health}_{ij} = \beta_0 + \beta_1\ \text{neighbourhood variable}_j + \beta_{2\text{-}5}\ \text{family SES indicator (1-4)}_{ij} + \beta_6\ \text{family welfare recipient}_{ij} + \beta_7\ \text{single parent family}_{ij}, + \beta_8\ \text{child's gender}_{ij} + \beta_9\ \text{grade retention}_{ij} + \beta_{10}\ \text{age}_{ij} + \beta_{11\text{-}12}\ \text{ethnicity indicator (1-2)}_{ij} + \mu_j + \varepsilon_{ij}$$

The ßs are the fixed regression coefficients; error terms reflect residual variation at neighbourhood (μ_j) and individual (ε_{ij}) level, and the neighbourhood variable was socioeconomic deprivation, ISC, or SC&T. In addition, a model was fitted with all three neighbourhood variables entered simultaneously, in order to assess the independent effects of measures of social capital and socioeconomic deprivation.

Since the analyses investigated two different data sets, and we expected interaction effects of ethnicity in one of the data sets we first analysed data for all Chicago respondents jointly, with interaction terms for ethnicity. The ethnicity variable was entered in the regression model as a categorical variable with Whites as the reference category and indicator variables for African American, Hispanic American, and others. These analyses showed that effects of the social capital variables on children's perceived health were modified by ethnic group, indicating that the effects in the Hispanic group were significantly different from those of the other groups. No interaction effects were found for the other ethnic groups. Therefore, stratified analyses were performed for 1) Maastricht children, 2) Chicago non-Hispanic children, i.e. Whites, African Americans and others and 3) Chicago Hispanic children.

Furthermore, analyses were carried out for the first two populations together, in order to examine whether the associations between the neighbourhood variables and perceived health were different in Chicago and Maastricht (i.e. interaction terms for city by the 3 neighbourhood variables).

Table 2: Pearson correlations between socioeconomic deprivation, informal social control (ISC), and social cohesion and trust (SC&T); neighbourhood level

	Maastricht		**Chicago (343)**		**Chicago (80)**	
	Deprivation	ISC	Deprivation	ISC	Deprivation	ISC
ISC	-0.68[a]		-0.60[a]		-0.50[a]	
SC&T	-0.87[a]	0.68[a]	-0.63[a]	0.80[a]	-0.47[a]	0.79[a]

[a] $p < 0.001$

Results

Social Capital

Both in Chicago and Maastricht socioeconomic deprivation, ISC and SC&T were highly and positively, albeit far from perfectly, correlated (table 2).

Table 3: Informal social control (ISC) and social cohesion & trust (SC&T) in Maastricht and Chicago

A All respondents of the community surveys (individual level)

	Maastricht	**Chicago** All	**Chicago** Whites	**Chicago** African Americans	**Chicago** Hispanic	**Chicago** other
ISC						
N	3184	8043	2156	3201	2006	635
Mean	15.10	17.33	18.31	16.81	17.22	17.02
SD	5.70	4.61	4.20	4.88	4.50	4.43
Min	5	5	5	5	5	5
Max	25	25	25	25	25	25
SC&T						
N	3349	7951	2128	3161	1978	636
Mean	19.15	16.81	17.91	16.34	16.43	16.58
SD	4.13	3.39	3.30	3.41	3.24	3.33
Min	5	5	5	5	6	5
Max	25	25	25	25	25	25

B Neighbourhood level

	Maastricht	**Chicago all neighbourhoods**	**Chicago selected neighbourhoods**	**Chicago Whites**	**Chicago Afr-Am**	**Chicago Hispanic**
ISC						
N	36	343	80	123	133	52
Mean	15.05	17.45	17.39	18.84	16.60	16.71
SD	0.98	1.97	1.68	1.76	1.83	1.21
Min	13.34	12.00	13.04	12.00	12.16	13.04
Max	17.46	22.14	21.16	23.15	21.10	19.29
SC&T						
N	36	343	80	123	133	52
Mean	18.99	16.92	16.88	18.11	16.24	16.02
SD	1.67	1.62	1.40	1.52	1.38	0.93
Min	16.62	12.71	13.81	13.79	12.71	14.52
Max	21.82	22.07	21.15	22.07	19.48	17.92

Table 3 shows higher levels of ISC and lower levels of SC&T in Chicago, concerning both the individual answers and the aggregated neighbourhood scores. Multilevel regression

analyses confirmed these descriptive findings: ISC levels were higher (β=2.42, $p<0.001$) and SC&T scores were lower in Chicago (β=-2.01, $p<0.001$; data not shown). Among the Chicago ethnic groups, the African American population reported the lowest levels of ISC and the White population the highest, whereas the Chicago Hispanic population had the lowest levels of SC&T and the Chicago Whites population the highest (table 3).

Standard deviations of ISC in Chicago all neighbourhoods (F=4.0, df=342, 35, $p<0.01$), Chicago White neighbourhoods[1] (F=3.2, df=122, 35, $p<0.01$) and Chicago African American neighbourhoods (F=3.49, df=132, 35, $p<0.01$) were significantly larger than the ISC standard deviation in Maastricht (see also table 3, section B). The standard deviation of ISC in Chicago Hispanic neighbourhoods differed significantly from the standard deviation in all Chicago neighbourhoods (F=2.7, df=342, 51, $p<0.01$), and was more similar to the standard deviation in Maastricht (F=1.5, df=51, 35, $p>0.05$). Standard deviations of SC&T were similar between Chicago all neighbourhoods, Chicago White neighbourhoods, African American neighbourhoods, and Maastricht neighbourhoods (Chicago all neighbourhoods: F=1.1, df=35, 342, $p>0.05$; Chicago White neighbourhoods: F=1.2, df=35, 122, $p>0.05$; African American F=1.5, df=35, 132, $p>0.05$ cf. Maastricht neighbourhoods). SC&T standard deviations in Chicago Hispanic neighbourhoods were significantly smaller than in Maastricht neighbourhoods (Hispanic F=3.2, df=35, 51, $p<0.01$). Standard deviations in both African

Table 4: Children's Perceived Health (1=excellent, 5=poor)

	Maastricht	**Chicago all**	**Chicago Whites**	**Chicago Afr-Am**	**Chicago Hispanic**	**Chicago Other**
N	533	801	110	298	359	30
Mean	2.00	2.16	2.03	2.01	2.36	1.87
SD	0.91	0.97	0.76	0.96	1.02	0.73
Min	1	1	1	1	1	1
Max	5	5	4	5	5	3
Fair / Poor	3.8 %	9.9 %	1.8 %	8.1 %	14.8 %	0 %

[1] We refer to White neighbourhoods when ≥ 50% of the inhabitants are Caucasians; to African American neighbourhoods when ≥ 50% of the inhabitants are African Americans and to Hispanic neighbourhoods when ≥ 50% of the inhabitants are of Hispanic origin.

American and Hispanic neighbourhoods were significantly smaller than in Chicago all neighbourhoods (African American $F=1.4$, $df=342, 132$, $p<0.05$; Hispanic $F=3.0$, $df=342, 51$, $p<0.01$).

Perceived Health

The percentage of children having fair or poor perceived health in Chicago (all ethnic groups combined) was more than twice as high as in Maastricht (table 4). However, the percentages of poor or fair health in Chicago White children and in Maastricht children was comparable. Within Chicago, the Hispanic group had the highest percentage poor or fair health (14.8%), followed by African American children (8.1%, table 4).

Interactions with Ethnicity

Analyses using data from all Chicago respondents showed ethnicity interaction effects. The effects of the ISC and SC&T on children's perceived health were modified by the Hispanic indicator variable, so that the effects in Hispanic children were significantly different from those in the other ethnic groups. No interaction effects were found for the other ethnicity indicator variables.

Associations between Neighbourhood Variables and Perceived Health

Socioeconomic deprivation and children's perceived health showed significant associations in the Maastricht population but not in the Chicago non-Hispanic populations (table 5). However, the interaction term for socioeconomic deprivation by city (Maastricht or Chicago) was not statistically significant ($p=0.19$). There was also an association between socioeconomic deprivation and children's perceived health in the Chicago Hispanic group, albeit statistically inconclusive by the conventional alpha criterion ($p = 0.057$).

Hispanic children living in neighbourhoods with higher levels of ISC had a better perceived health (table 5). The strength of the association between ISC and children's health in Maastricht was in the same direction but not as strong as in Chicago Hispanic children, and was statistically imprecise by conventional alpha ($p=0.058$). ISC was not associated with children's health in the Chicago non-Hispanic group, and the interaction term for city by ISC was statistically significant ($p=0.048$).

Higher levels of SC&T were significantly associated with higher levels of perceived health in Maastricht children. This was not so in the group of Chicago non-Hispanic children's health and the interaction term for city by SC&T was suggestive for interaction ($p=0.052$).

Table 5: Multilevel regression analysis: Socioeconomic deprivation, informal social control (ISC) and social cohesion and trust (SC&T) as the main independent variables and children's perceived health as the dependent variable (βs and 95% confidence intervals (CI)).

	Maastricht children (n=468) β (CI)	**Chicago non-Hispanic children (n=436) β (CI)**	**Chicago Hispanic children (n=359) β (CI)**
Crude analyses			
Socioeconomic deprivation	0.10 (0.02; 0.18)	0.0007 (-0.10; 0.10)	0.21 (-0.03; 0.45)
ISC	-0.09 (-0.17; -0.01)	0.01 (-0.04; 0.06)	-0.13 (-0.21; -0.06)
SC&T	-0.07 (-0.12; -0.02)	0.02 (-0.03; 0.08)	-0.11 (-0.20; -0.02)
Confounders only			
Family SES (low)	0 (reference)	0 (reference)	0 (reference)
	-0.01 (-0.27; 0.25)	0.006 (-0.30; 0.32)	-0.13 (-0.42; 0.15)
	-0.18 (-0.43; 0.07)	-0.21 (-0.49; 0.06)	-0.12 (-0.43; 0.18)
	-0.10 (-0.36; 0.15)	0.096 (-0.16; 0.36)	-0.05 (-0.36; 0.26)
(high)	-0.17 (-0.43; 0.08)	0.033 (-0.22; 0.29)	-0.62 (-1.00; -0.22)
Single parents	0.15 (-0.10; 0.40)	0.007 (-0.19; 0.20)	-0.03 (-0.25; 0.31)
Gender	0.07 (-0.10; 0.23)	-0.006 (-0.18; 0.16)	0.12 (-0.09; 0.33)
Grade retention	0.15 (-0.17; 0.47)	-0.11 (-0.42; 0.20)	0.37 (-0.02; 0.77)
Age	not in model[a]	0.04 (-0.13; 0.22)	0.16 (-0.07; 0.38)
Whites (MQoL: Dutch)	0 (reference)	0 (reference)	-
African American	-	-0.002 (-0.21; 0.21)	-
Other (MQoL: non-Dutch)	0.008 (-0.26; 0.28)	-0.15 (-0.52; 0.21)	-
Socioeconomic deprivation[b]			
	0.095 (0.002; 0.19)	0.009 (-0.12; 0.13)	0.23 (-0.007; 0.48)
Improvement cf. confounders only	Chi^2=3.95 p=0.047	Chi^2 = 0.02 p=0.89	Chi^2 = 3.65 p=0.056
ISC[b]	-0.09 (-0.18; 0.003)	0.002 (-0.05; 0.06)	-0.12 (-0.20; -0.05)
Improvement cf. confounders only	Chi^2=3.58 p=0.059	Chi^2=0.01 p=0.93	Chi^2=10.29 p=0.0013
SC&T[b]	-0.06 (-0.12; -0.006)	0.01 (-0.05; 0.08)	-0.11 (-0.20; 0.02)
Improvement cf. confounders only	Chi^2=4.75 p=0.03	Chi^2=0.16 p=0.69	Chi^2=5.21 p=0.02
Socioeconomic deprivation			
	-0.03 (-0.29; 0.23)	-0.01 (-0.14; 0.16)	0.11 (-0.14; 0.37)
ISC	-0.04 (-0.16; 0.08)	-0.02 (-0.13; 0.09)	-0.12 (-0.22; 0.02)
SC&T	-0.06 (-0.21; 0.09)	0.03 (-0.08; 0.14)	0.013 (-0.11; 0.14)
Improvement cf. confounders only	Chi^2=5.15 p=0.16	Chi^2=0.37 p=0.95	Chi^2=11.10 p=0.01

a Age was included in the PHDCN data analyses, but not in the Maastricht analyses because of collinearity between grade retention and age: because of the sampling method only the children who doubled a grade were not aged 11 or 12.

b Controlled for family SES, single parent families, child's gender, grade retention, age and ethnicity (Whites, African American, other).

However, the association between SC&T and Hispanic children's health was statistically significant and in the same direction as in the Maastricht children.

In order to assess the independent effects of measures of social capital and socioeconomic deprivation, a model was fitted with all three neighbourhood variables. In this model, none of the above associations remained significant, except for ISC in Chicago Hispanic children.

Discussion

Sociocultural Differences

Our results indicated that Maastricht had lower levels of ISC, while Chicago had lower levels of SC&T. The differences in both ISC and SC&T between the two cities are approximately half a standard deviation. Furthermore, ISC showed more variation in Chicago neighbourhoods, suggesting sharper contrasts between neighbourhoods. These differences may reflect true differences in community functioning in Maastricht and Chicago or may reflect differences in the way respondents understood and answered the questions in each study.

The present study showed statistically significant associations between socioeconomic deprivation and SC&T on the one hand and the Maastricht children's perceived health on the other. There were also significant associations between ISC and SC&T on the one hand and Chicago Hispanic children's health. Furthermore, associations between ISC and Maastricht children's health, and between socioeconomic deprivation and Chicago Hispanic children's health were apparent albeit statistically imprecise by conventional alpha. Socioeconomic deprivation, ISC, and SC&T were not associated with children’s health in the Chicago non-Hispanic samples. All associations were in the expected directions: lower levels of social capital and higher levels of socioeconomic deprivation were associated with lower levels of perceived health.

Although socioeconomic deprivation was associated with Maastricht children's health and not with Chicago non-Hispanic children's health, the interaction effect between city (Maastricht or Chicago non-Hispanics) and socioeconomic deprivation was not statistically significant. This indicates that although the confidence interval in Maastricht does not include 0 (=no effect) and the confidence interval for Chicago non-Hispanics does, the confidence intervals of the two cities overlap. Therefore, we cannot assert that the associations between socioeconomic deprivation and children's perceived health actually differed between Maastricht and Chicago non-Hispanic children. On the other hand, we can conclude that the effect of ISC, and the more imprecise effect of SC&T did differ between the two cities.

Two differences between Chicago and Maastricht may account for the different effects of socioeconomic deprivation and social capital on perceived health in Chicago and Maastricht. Firstly, differences in individual incomes, and consequently differences in neighbourhood socioeconomic deprivation, are much smaller in Maastricht than in Chicago. In the Netherlands, there is a strong historical tradition of sobriety and what has been termed "the embarrassment of riches" that has created a moral geography that negatively values extreme displays of material advantage or disadvantage (Schama, 1988). This tradition has resulted in the constitution of a model European "caring state" in the Netherlands, which functions to prevent various forms of social exclusion through a relatively strong social safety net (Kleinhans et al., 2001, Thompson, 2000, De Swaan, 1988). In the United States, by contrast it could be argued that a culture of individualism and commitment has resulted in a public policy that has reformed the safety net with policies and programs that emphasise "workfare" in which individuals are forced out of dependency on the welfare system and encouraged to shift their commitments to the mainstream work ethic (Palley and Belcher, 1996, Mead, 1986, Mead, 1992). If this is the case then although socioeconomic deprivation was measured in both Chicago and in Maastricht as a continuous variable with a mean of 0 and unity standard deviation, one standard deviation in Maastricht is not the same as one standard deviation in Chicago and the effect sizes of socioeconomic deprivation can, therefore, only cautiously be compared. However, if this were the reason for different effects of the neighbourhood variables on children's health, we would have expected greater effects in Chicago children than in Maastricht children. In addition, neighbourhood socioeconomic deprivation was based on a slightly different set of variables for each city. However, since the overlap was high, we feel that it is safe to assume that the Chicago and the Maastricht socioeconomic deprivation variables reflect the same underlying construct.

Secondly, the impact of Government on housing may be different in the Netherlands and in the United States. In the Netherlands specialised local corporations manage the housing that is provided to underprivileged families. Such housing projects are generally geographically spread throughout the city and there is a strong public policy against residential segregation. In Chicago neighbourhoods government housing policy for the disadvantaged has tended to lead to the concentration of the disadvantaged in large housing estates (Kleinhans et al., 2001). Thus, Maastricht neighbourhoods are more mixed than Chicago neighbourhoods. This may explain the greater variation in ISC in Chicago. However, variation in SC&T was similar in the present study. Currently, Dutch sociologists argue that

social cohesion is stronger in homogeneous neighbourhoods than in the neighbourhoods that are forced to be mixed by the new policy of local authorities (Duyvendak, 2001).

Interactions with Ethnicity

Chicago is a multi-ethnic city but people from different ethnic groups tend to live in different neighbourhoods. Our results showed that Hispanic American children were more sensitive to neighbourhood factors than non-Hispanic American children, even though mean ISC and SC&T were similar in different ethnic groups, and variance was lowest in Hispanic neighbourhoods. The lower mean perceived health and higher percentage poor or fair health indicate a higher variability of the outcome measure in Hispanic American children. However, if this variability alone were responsible for the interaction effect in the Hispanic children, we would not expect to find any association between neighbourhood factors and perceived health in Maastricht children. Contrary to this, we demonstrated an effect of neighbourhood on perceived health in this low variability group.

Explanations for Hispanic American health-related outcomes are complex. Specific features of organisation of Hispanic American communities are likely to play a role. Hispanic Americans, in 1993, generally had lower educational attainment, were more likely to have dropped out of school, and were more likely to live without health insurance than Americans of other ethnicities (Shinagawa and Jang, 1998). Whereas the annual income of the total Hispanic group (families, couples and single persons together) and the total African American group were comparable, the income of Hispanic families was lower than the income of African American families, and more Hispanic children lived in poverty (Shinagawa and Jang, 1998). However, compared to African American and other communities, Hispanic neighbourhoods may have a higher degree of institutional completeness that may strongly mediate the relatively higher degree of social disadvantage (Tsukashima, 1985, Valdez, 1993). The institutional order found in the Hispanic American communities are characterised by strong extended family structures, intergenerational community-owned businesses and strong Roman Catholic churches that stimulate community organisational processes, shared child control, and social capital (Sampson et al., 1999).

Furthermore, Hispanics may respond differently to the social capital questions, because they have other norms than other ethnic groups, as a result of the strong extended family structures in their neighbourhoods. This could result in biased estimates of social capital in Hispanic neighbourhoods (Subramanian et al., 2003). More comparative cross-national

research is needed to understand why social capital affects children's health in one cultural setting or ethnic group and not in another.

Other Methodological Issues

When models were fitted with socioeconomic deprivation, ISC and SC&T jointly, most effects did not remain statistically significant, as was to be expected given the high correlations between these neighbourhood variables (collinearity). This does not indicate that the effects do not exist, but rather that all neighbourhood variables have comparable influences on child health status. Therefore, models entering only one neighbourhood variable at a time were used to estimate and interpret their effects.

Unfortunately, the intra class correlations (ρ) were low in all 3 populations (Maastricht, Chicago non-Hispanics, Chicago Hispanics) and only the Chicago Hispanics showed statistically significant variation in self-rated health at neighbourhood level (σ_μ^2). However, neighbourhood researchers tend to analyse neighbourhood effects, even when the intra class correlation and the neighbourhood variation are low, and it is generally held that this is warranted (Raudenbush and Sampson, 1999).

A common problem in cross-national research is that exact comparability of data collection and coding procedures are unlikely to be achieved in practice. An effort was made to establish the equivalence of US and Dutch concepts and indices, and to achieve "comparability of meaning" in data collection and coding at the indicator and concept levels, whilst acknowledging technical differences in instruments and their situational translations (Kohn et al., 1990a, Ragin, 1989). When translating questions into another language, it is possible that the comparability of meaning will be reduced or obscured. This could have been the case both in the social capital questions and in the perceived health question. However, the perceived health question has proven to be robust for semantic variations in questions (Idler and Benyamini, 1997). In addition, the social capital questions were back-translated into English and we think that the meaning is almost perfectly equivalent. There is always the slight possibility that questions are interpreted differently because of differences in culture, but this is inevitable in cross-cultural research (Kohn et al., 1997).

In addition, methodological differences between the two samples could have contributed to the observed results. Firstly, the Chicago sample was somewhat older. However, analyses with the Chicago Hispanic children yielded a similar pattern of results as with the Maastricht children. Secondly, the difference in administration of the questionnaires between the PHDCN and the MQoL may have influenced the results. Children might be more honest when

answering an anonymous questionnaire, but an interviewer can explain a question if the child does not appear to understand it. The biggest differences, however, were found between Chicago non-Hispanic children and Chicago Hispanic children, both from the PHDCN study. Finally, on average the Maastricht neighbourhoods were a bit smaller.

Another methodological limitation of the study could be the measurement of the ethnicity variable. It is customary in other PHDCN studies to include ethnicity measures both at the individual level and at the neighbourhood level. Both the PHDCN and the MQoL deprivation measures included ethnicity (PHDCN % blacks) as one of the factors (see methods). For the purpose of our comparative analysis of different cultural settings, we included individual-level ethnicity only, next to the deprivation measures. The lack of variability in terms of ethnicity in Maastricht data did not warrant the inclusion of ethnicity at the neighbourhood level as a meaningful ecological variable, other than as one of the components of the socioeconomic deprivation measure. Hispanic ethnicity was not included in the PHDCN deprivation measure. However, it is unlikely that including neighbourhood Hispanic ethnicity would nullify the interaction effect of Hispanic ethnicity. Including a neighbourhood measure of Hispanic ethnicity may only reveal whether the interaction is a neighbourhood-level or an individual-level interaction.

All reported effects of social capital could have been the result of family-level control and cohesion rather than neighbourhood-level social capital. However, Drukker and colleagues (Drukker et al., 2003) analysed data on social capital and health-related quality of life with and without possible family equivalents of social capital as additional confounders: parental stress and child's satisfaction about parents and relatives. Since all effects remained similar, it is likely that the effects found in the present study are also the result of neighbourhood-level social capital rather than family cohesion and control.

Finally, since the present paper describes baseline data from the PHDCN and the MQoL, longitudinal relationships that may shed light on causality could not be examined.

Conclusion

The present paper shows that social capital and its effects can be measured and interpreted across different sociocultural settings and national contexts. Socioeconomic deprivation, ISC and SC&T on the one hand and children's perceived health on the other seem to have different magnitudes in different populations. More focused research is needed to further study these differences in effect and to provide satisfactory theoretical interpretations.

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3.3 Social capital and mental health versus objective measures of health in the Netherlands

Previously, it has been reported that social capital in the neighbourhood may be beneficial for mental health in adults and children. We wished to investigate whether such effects were accompanied by similar effects on physical development, and investigated sensitive, cumulative objective measures of child health, height and weight at different ages, in relation to the neighbourhood environment. Results showed that none of the social capital measures were associated with any of the outcomes. We conclude that neighbourhood measures play a role in mental health, but that effects are more readily expressed in the psychological rather than the physical domain, in children living in the Netherlands.

Drukker, M., Gunther, N., Feron, F. J. M. and Van Os, J. (2003) 'Social capital and mental health versus objective measures of health in The Netherlands', British Journal of Psychiatry, 183, pp. 174.

The letter is included in the CD-ROM, which is enclosed in the complete version of this PhD thesis (back flap)

The BRITISH JOURNAL OF PSYCHIATRY (2003), 183, 170-175

Correspondence

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Contents ■ Explanatory models in psychiatry ■ Ethnic differences in prisoners: describing trauma and stress ■ Specialist care for prisoners? ■ Consent and treatment in and treatment prisons ■ Amisulpride-induced mania in a patient with schizophrenia ■ Changing use of ECT ■ Inappropriate use of psychostimulants ■ Stigma as a cause of suicide ■ Social capital and mental health v. objective measures of health in The Netherlands

The BRITISH JOURNAL OF PSYCHIATRY (2003), 183, page 174

Social capital and mental health v. objective measures of health in The Netherlands

McKenzie et al (2002) reported that social capital in the neighbourhood may be beneficial for health and mental health in adults. We have reported associations between neighbourhood social capital and mental health service use in children (Van der Linden et al, 2003). We wished to investigate whether such effects on mental health were accompanied by similar effects on physical development, and investigated sensitive, cumulative objective measures of child health, height and weight at different ages, in relation to the neighbourhood environment.

We recorded all height and weight data registered regularly in the Municipal Youth Health Care Centre from birth up to the baseline measurement of our cohort study of 1009 children aged approximately 11 years living in the 36 neighbourhoods of a Dutch city (response rate of both child and one parent of 54%) (Drukker et al, 2003). This study on the effects of neighbourhood variables also included family-level and child-level measures, such as family socioeconomic status. In addition, social capital dimensions of (a) informal social control and (b) social cohesion and trust were measured in a community survey and aggregated to neighbourhood level. Data were part of a three-level structure with height and weight measurements at different ages nested within children, and children nested within neighbourhoods. Growth curves were estimated using a multi-level random-effects regression model (including age and age^2). The outcome measures were height, weight, and body mass index (weight/height^2), and all variables except for age were considered fixed factors. When neighbourhood variables and individual level confounders were added to the models, results showed that none of the social capital measures was associated with any of the outcomes.

Therefore, we conclude that neighbourhood measures play a role in mental health, but that effects are more readily expressed in the psychological rather than the physical domain, in children living in The Netherlands.

Drukker, M., Kaplan, C.D., Feron, F. J. M., *et al* (2003) Children's health-related quality of life, neighbourhood socio-economic deprivation and social capital. A contextual analysis. Social Science and Medicine, **57**, 825-841.

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3.4 Neighbourhood socioeconomic and social factors and school achievement in boys and girls

Background Previous research showed that school achievement of children living in poor neighbourhoods was lower. The present paper hypothesised a role of another neighbourhood measure, social capital.
Methods Multilevel (cross-level) analyses were conducted using neighbourhood level, school level, and individual level data. Individual data of 11-year olds were obtained from the baseline measurement of a family cohort study. Maastricht schools provided additional data on school achievement scores. Neighbourhood socioeconomic deprivation was based upon objective measures obtained from the authorities, while neighbourhood social capital measures were based on aggregated answers on a community survey questionnaire.
Results Although school achievement scores were lower in socioeconomically deprived neighbourhoods and in neighbourhoods with lower levels of social cohesion and trust, these differences could be attributed to individual level differences. However, lower levels of neighbourhood informal social control were associated with lower school achievement scores, in boys. There were no interaction effects between neighbourhood socioeconomic deprivation and the social capital variables.
Conclusions In Maastricht, there is no evidence that socioeconomic deprivation impacts on school achievement. On the other hand, one particular aspect of social capital, i.e. informal social control, appeared to be associated with school achievement in boys.

Drukker, M., Feron, F. J. M. and Van Os, J. (submitted) 'Neighbourhood socioeconomic and social factors and school achievement in boys and girls'

Full article is included in the CD-ROM, which is enclosed in the complete version of this PhD thesis (back flap)

Neighbourhood socioeconomic and social factors and school achievement in boys and girls

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Abstract
Previously school achievement was reported to be lower in children living in poor neighbourhoods. The present paper hypothesised a role of neighbourhood social capital. Data of 11-year olds were obtained from the baseline measurement of a family cohort study (n=343). The data had a cross level structure: neighbourhood level, school level, and individual level. The results showed that school achievement scores were lower in socioeconomically deprived neighbourhoods and in neighbourhoods with lower levels of social cohesion and trust. After including individual level confounders, these associations disappeared. However, lower levels of neighbourhood informal social control were associated with lower school achievement scores in boys. Thus, for boys a higher levels of informal social control may be conducive to superior educational achievement.

Introduction

The neighbourhood environment may be an important determinant of school achievement and drop-out (Brooks-Gunn, et al., 1993; Leventhal & Brooks Gunn, 2000; Quane & Rankin, 1998). Lower levels of school achievement may have consequences for future job opportunities and earnings (Ensminger, Lamkin & Jacobson, 1996; Entwisle, Alexander & Olson, 1994), resulting in a vicious circle of limited chances for children living in poor neighbourhoods, so that their offspring also grow up in deprived socioeconomic conditions. Effects on scholastic achievement may be mediated in part by lower expectations of teachers and/or by influences of peers and young adult drop-outs (Quane & Rankin, 1998; Wilson, 1987).

Ghettorisation of a neighbourhood may contribute to the relative isolation of residents from mainstream values on work and education (Wilson, 1987), resulting in deviant norms and values. The proportion of young adult males who had not graduated has been identified as the most important predictor of male achievement (Connell & Halpern-Felsher, 1997; Quane & Rankin, 1998). Norms and values on education of young adult role models are more easily spread when the societies are close-knit (Connell & Halpern-Felsher, 1997). On the other hand, a controlling environment may extort obedience to norms and values. Depending on the dominant norms and values, this may improve school achievement. Therefore, neighbourhood social capital may also have an important impact on school achievement of the residing children, independent of or in interaction with socioeconomic deprivation. However, although associations between neighbourhood poverty and school achievement have been widely studied (Brooks-Gunn, et al., 1993; Leventhal & Brooks Gunn, 2000), studies on this other and arguably more relevant aspect of the social environment, social capital, are scarce.

Social capital has been defined as "those features of social organizations - such as networks of secondary associations, high levels of interpersonal trust and norms of mutual aid and reciprocity - which act as resources for individuals and facilitate collective action" (Coleman, 1990; Kawachi, et al., 1997; Putnam, 1993). The measurement of neighbourhood level social capital relies mainly on the subjective information supplied by community members, the best informants of social processes in their own neighbourhood. To avoid contamination by individual perceptions of the study population, social capital measures should be collected in a sample of informants independent of the study sample (Buka, et al., 2003). Neighbourhood social capital has been reported to contribute to better health, mental health, behaviour, and well-being in children and adults, over and above individual measures (Aneshensel & Sucoff, 1996; Drukker, et al., 2003; Kawachi, Kennedy & Glass, 1999; McKenzie, Whitley & Weich, 2002; Sampson, Raudenbush & Earls, 1997). Furthermore, it has been hypothesised that lower levels of parental supervision may be responsible for the fact that children of single mothers give lower importance to school achievement (Quane & Rankin, 1998), and parental involvement was reported to explain behaviour but not school achievement outcomes (McNeal, 1999). Both parental involvement and parental supervision may be considered as family equivalents of neighbourhood social capital.

Neighbourhood social environment may be most important in adolescents, because adolescence is a time during which children become increasingly independent and autonomous, and spend more time in neighbourhood settings away from family and school (Allison, et al., 1999), experiencing more impact from their peers. In addition, many previous studies reported greater effects of the neighbourhood on school achievement in boys than in girls, and it has been argued that this difference may result from the fact that boys spend more time in the neighbourhood than girls (Connell & Halpern-Felsher, 1997; Ensminger, et al., 1996; Entwisle, et al., 1994; Leventhal & Brooks Gunn, 2000).

The present paper reports on the association between neighbourhood level social capital and socioeconomic deprivation on the one hand and school achievement in adolescent boys and

girls on the other. Two *a priory* sets of interaction terms were studied (1) socioeconomic deprivation by social capital (2) neighbourhood variables by gender.

Methods

The Maastricht population consists of 122 000 inhabitants. Twenty percent have a non-Dutch nationality and six percent are of non-Western origin. Maastricht consists of 36 residential neighbourhoods, housing between 300 and 8500 inhabitants (mean 3337). These neighbourhoods were defined by Statistics Netherlands (CBS), who defined neighbourhoods throughout the Netherlands. These neighbourhood definitions are widely used and the boundaries, following main roads, are ecologically meaningful.

The Maastricht University department of Psychiatry and Neuropsychology and the Youth Health Care Division (YHCD) of the Municipal Health Centre launched a longitudinal cohort study of children in Maastricht neighbourhoods (hereafter: family cohort). The study aims to follow up a cohort of children aged approximately 11 years at baseline into adulthood. At baseline, the children and their parents were asked to fill in a questionnaire on individual and family variables. The present paper links data from this questionnaire to data on school achievement and to neighbourhood level social and socioeconomic data.

School achievement

A uniform system to objectively measure school achievement has been used in primary schools throughout The Netherlands for decades. The system is developed to advise children in the top grade of the primary school (aged 12 years) which secondary school fits best (Final Test of Primary Education) (CITO groep, 2004). In addition, the system also supplies a test for children aged 11 years. Twenty three of the 38 Maastricht primary schools administered this test a few months before the data collection of the cohort study. Children of these 23 schools lived in 31 of the 36 Maastricht residential neighbourhoods. School achievement results are summarised in a total score, which expresses the percentage of all Dutch children that scored lower than the concerning child (percentile score).

The parents were asked to give informed consent for using the questionnaire data of the children. In addition, they gave consent to use school achievement data of their children.

Neighbourhood socioeconomic deprivation

The city of Maastricht Municipal Statistics Department and CBS supplied objective neighbourhood data on various (socioeconomic) variables. In order to summarize these data into a lesser number of underlying constructs, a principal components factor analysis (without rotation) was carried out and the most important identified factor was "socioeconomic deprivation" (Drukker, et al., 2003). Percentage single parent families, ethnicity, non-voters, unemployment, unemployment more than 1 year, social security, social security more than 3 years, mean income, mean income for persons employed 52 weeks a year, percentages high and low incomes, and percentage economically inactives loaded on this factor. Factor scores were calculated, yielding a continuous variable with mean 0 and unity standard deviation. Higher scores indicated more socioeconomic deprivation and this variable had a normal distribution.

Neighbourhood social capital

In order to assess social capital, approximately 200 inhabitants aged 20 to 65 years were randomly selected from each of 36 Maastricht neighbourhoods, using the municipal database (hereafter: community survey). These inhabitants received a questionnaire on social capital,

which they were asked to send back. Social capital was measured using two collective efficacy scales: informal social control (hereafter: ISC) and social cohesion and trust (hereafter: SC&T), developed by Sampson and colleagues (Sampson, et al., 1997). Both scales were translated into Dutch and back translated into English. In order to adapt the ISC scale to the Dutch situation, five items corresponding to typical Dutch concerns were added (see appendix). The ISC scale measures the willingness to intervene in hypothetical neighbourhood-threatening situations, for example in the case of children misbehaving or the opening of a sex club in the street. This scale is conceived in such a way that respondents are independent informants about their neighbours' willingness to intervene. The SC&T scale measures bonds and trust among the residents of the neighbourhood (see appendix). Both the ISC and SC&T scale are scored negatively; thus, higher scores indicated lower levels of social capital. Before analyses both variables were standardized to unity standard deviation.

Individual and family level variables

The neighbourhood social environment was the main interest in the present paper. However, associations can only be attributed to the neighbourhood environment after controlling for individual level variables (multilevel analyses). Only if models include the individual (or family) level equivalents of neighbourhood variables and other confounders can results give evidence that there is an association between the neighbourhood variable and the outcome over and above individual differences (Snijders & Bosker, 1999).

Family occupational status, educational status, and welfare recipient status can be considered as individual level equivalents of neighbourhood socioeconomic deprivation and, therefore, were hypothesized to be confounders. Including occupational status and educational status in the analyses guarantees satisfactory control for individual level socioeconomic status in the Netherlands (Van Berkel-Van Schaik & Tax, 1990). Occupational status was measured using information on current or last profession, scored according to the International Socio-Economic Index of occupational status ISEI-92 (Ganzeboom, De Graaf & Treiman, 1992). In addition, the questionnaires assessed the highest level of completed education. Family occupational and educational status were based on the parent with the highest occupational status and educational status, respectively.

Guided by previous work (Drukker, et al., 2003; Van der Linden, et al., 2003), single parent family status and gender were also considered as potential confounders.

Finally, a variable measuring the quality of child-parent interaction at baseline was included in the models as a family level equivalent of neighbourhood social capital, in order to ensure control for family level processes. This variable, parental perceived difficulty (in child raising), was measured using the NOSIK (Nijmegen Parental Stress Index Short Version), a Dutch 25-item questionnaire (items such as "I have much more problems raising my child than expected", and "I notice that I am less able to take care of my child than expected" (Brock, et al., 1992)). Sum scores of the 11 items of the parent domain were used in the present analyses.

Statistical analyses

The data were part of a complex multilevel structure with level-one units (children) structured into level-two units (neighbourhoods). Because only one child per family was included in the analyses, individual and family variables were both level-one variables. Although the focus was on neighbourhood level measures, measures of school achievement are also clustered within schools. Children attending the same school did not all live in the same neighbourhood and children residing in the same neighbourhood did not all attend the same school. The data therefore had a cross-classified structure, and were correspondingly subjected to cross level regression analysis in order to investigate neighbourhood associations while controlling for

individual and family effects and controlling for the clustering of children within schools (Rasbash, et al., 2000). Multilevel or cross level linear regression techniques are a variant of the more often used unilevel linear regression analysis and are ideally suited for the analysis of clustered data (Snijders & Bosker, 1999). The βs are the regression outcomes of the predictors in the multilevel model and can be interpreted identically to the estimates in the unilevel analyses. All multilevel analyses were performed using MLWIN (Rasbash, et al., 2000).

The model included all individual level variables described above. Because effect non-linearities were observed for occupational status, this continuous variable was collapsed into 5 categories. In order to avoid the exclusion of subjects having a missing value from the analyses, the missing values of educational status and occupational status were entered in the model as an extra category. Parental occupational status, parental educational status, and parental perceived difficulty were entered as dummy variables in the equation, high occupational status, high educational status, and few parental problems being the reference categories. This resulted in the following cross level equation (1):

School achievement = β_0 + β_1 neighbourhood variable$_j$
+ $\beta_{2\text{-}6}$ occupational status dummy(1-5)$_{ij}$ + $\beta_{7\text{-}12}$ educational status dummy(1-6)$_{ij}$
+ β_{13} family welfare recipient$_{ij}$ + β_{14} single parent family$_{ij}$
+ $\beta_{15\text{-}18}$ parental perceived difficulty (1-4) + β_{19} child's gender$_{ij}$ + $\varepsilon_{i(jk)}$ + μ_j + μ_k

The ßs are the fixed regression coefficients; the error terms reflect residual variation at individual ($\varepsilon_{i(jk)}$), neighbourhood (μ_j) and school level (μ_k). The neighbourhood variable, socioeconomic deprivation, informal social control, or social cohesion and trust, were entered in the model separately because of the risk of collinearity (Drukker, et al., 2003).

Since higher scores on the outcome variable indicated better school achievement and higher scores for the neighbourhood variables indicated more deprivation and lower levels social capital, we expected the βs of the neighbourhood variables to be negative.

In addition, two sets of *a priory* interaction terms were added to the models. First, neighbourhood socioeconomic deprivation by social capital interaction terms were included (neighbourhood socioeconomic deprivation * informal social control; and neighbourhood socioeconomic deprivation * social cohesion and trust). Second, the addition of interactions with gender resulted in the following cross level equation (2):
Equation (1) + β_{20} neighbourhood variable * gender

When there was evidence for an interaction with gender, this model was used to calculate βs for boys and for girls.

Table 1: Means, standard deviations (stdev) and Pearson correlation coefficients of socioeconomic and social capital variables

	descriptives				Pearson correlations	
	n	**mean**	**stdev**	**range**	**ISC**	**SC&T**
Socioeconomic deprivation	35	0.00	1.0	-1.7 – 1.7	0.7[†]	0.9[†]
Informal social control[a]	36	29.1	1.9	24.5 – 32.8	1.0	0.7[†]
Social cohesion and trust[a]	36	22.3	3.4	16.7 – 28.0		1.0

[a] Standardised before analyses (sd=1).
[†] $p<0.001$

Results

Response and school achievement percentiles

Fifty-seven percent of the children responded and sixty percent of the families returned a parent questionnaire. Fifty-four percent of the families returned both one adult questionnaire and the child questionnaire.

Of all families in which both a child and an adult returned a questionnaire, school achievement figures were available for 343 children. Fifty per cent of these children were boys. Most children were aged 11 years (74%). Fourteen per cent of the children lived in single parent families. Eighteen per cent of the families reported that the parent with the highest occupational status had a profession for which only elementary or lower level education was required.

Table 2: Associations between neighbourhood variables and school achievement percentile scores (CITO); regression coefficients (βs) and 95% confidence intervals (CI)

	β	95% CI	
Crude analyses			
socioeconomic deprivation	-4,87*	-8,69;	-1,06
informal social control[a]	-4,07*	-7,29;	-0,84
social cohesion and trust[a]	-4,07*	-7,85;	-0,30
Individual (and family) level variables only			
Occupational status:			
high (reference)	0		
low	-4,31	-14,74;	6,13
low intermediate	0,80	-9,40;	11,00
intermediate	3,70	-5,78;	13,18
high intermediate	1,11	-7,35;	9,57
Educational status:			
university (reference)	0		
elementary	-31,13†	-42,42;	-19,84
lower secondary	-32,83†	-44,98;	-20,69
intermediate vocational	-26,68†	-37,16;	-16,20
higher secondary	-13,86†	-24,21;	-3,51
higher vocational	-13,57**	-22,16;	-4,98
Family welfare recipient status (yes cf no)	-14,85*	-27,3;	-2,38
Single-parent family	1,40	-6,50;	9,29
Parental perceived difficulty			
few problems (reference category)	0		
	-0,31	-8,37;	7,75
	2,88	-4,86;	10,62
	0,21	-7,76;	8,17
highest category of problems	-3,75	-11,88;	4,38
Child's gender (1=♂ 2=♀)	-2,45	-7,55	2,65

[a] Standardised before analyses (sd=1).

* p<0.05 ** p<0.01 † p<0.001

Per definition, the mean percentile score throughout the Netherlands is 50%. The mean score of the Maastricht children was 58% (standard deviation: 27.2). The mean score per school ranged between 25% and 77%. Table 1 presents descriptives and Pearson correlations of the neighbourhood variables.

Associations between individual and family level variables and school achievement
School grades of children from welfare receiving families were significantly lower than the grades of the other children (table 2). In addition, school achievement of children from lower educated parents was lower. When this variable was excluded from the analysis, the other indicator of family socioeconomic status, lower occupational status, was also associated with lower levels of school achievement.

Socioeconomic deprivation by social capital interactions
Results did not show interaction effects between neighbourhood socioeconomic deprivation and the social capital variables. Therefore, these interaction terms were not included in the models.

Association between neighbourhood variables and school achievement for boys and girls
The mean school achievement scores were lower in neighbourhoods with higher levels of socioeconomic deprivation, lower levels of informal social control, and lower levels social cohesion and trust (neighbourhood factors included separately in the models).

Although statistically imprecise by conventional alpha, there was evidence for interaction effects between gender on the one hand and neighbourhood socioeconomic deprivation, informal social control, and social cohesion and trust on the other (respectively p=0.09, p=0.10, p=0.07). The dynamics of this interaction were further clarified by calculating βs of the neighbourhood variables for girls and boys. This resulted in one large and statistically significant association only: lower levels of neighbourhood informal social control were associated with lower school achievement scores in boys (table 3).

Table 3: Associations between neighbourhood variables and school achievement for boys and girls (controlled for individual-level confounders[a])

	boys		girls	
	β	**95% CI**	**β**	**95% CI**
socioeconomic deprivation	-1,89	-6,34; 2,56	3,10	-1,44; 7,64
informal social control[b]	-3,96[*]	-7,85; -0,07	0,41	-3,38; 4,20
social cohesion and trust[b]	-1,92	-6,30; 2,45	3,31	-1,03; 7,65

[a] i.e. child's gender, family welfare recipient status, single parent family, parental perceived difficulty, occupational status, educational status
[b] Standardised before analyses (sd=1).

[*] p<0.05 [**] p<0.01 [†] p<0.001

Discussion

The results showed that school achievement scores were lower in socioeconomically deprived neighbourhoods and in neighbourhoods with lower levels of social capital (i.e. informal social control, or social cohesion and trust). After controlling for individual level demographic and socioeconomic factors, the association between socioeconomic deprivation and social cohesion and trust on the one hand and school achievement on the other disappeared, both in boys and in girls. The results of socioeconomic deprivation were in agreement with a previous study in the U.S., which did not find evidence for an effect of neighbourhood poverty, after controlling for individual characteristics (Quane & Rankin, 1998).

Although neighbourhood poverty did not impact on the school results, another aspect of the neighbourhood environment did play a role, independent of individual level differences, albeit in boys only. In this group, school achievement was specifically associated with informal social control. This is in agreement with previous results of the present cohort study, which showed that mental health and behaviour were also specifically associated with informal social control in children aged approximately 11 years (Drukker, et al., 2003). Thus, for children (in particular boys) higher levels of informal social control may be conducive to a more healthy psychological and educational development. This interpretation finds support in the general strain theory (Aseltine, Gore & Gordon, 2000). This theory emphasizes the role of adolescent's affective responses to negative life experiences in causing deviant behaviour. The theory also implies that adolescent negative emotionality when coupled with low social control will be more likely to react to the strains of normal developmental change with an abnormal breakdown of norms and values, including concerning the importance of school grades.

Differences between boys and girls

The present findings showed that boys seemed to benefit from living in a more controlling environment while girls did not. Previous research also reported neighbourhood effects for boys only and it has been hypothesised that this results from the fact that boys spend more time in the neighbourhood than girls (Connell & Halpern-Felsher, 1997; Ensminger, et al., 1996; Entwisle, et al., 1994; Leventhal & Brooks Gunn, 2000). As far as we know, this is the first paper that reports on controlling environment and school achievement, and next to the above-mentioned general hypothesis another more specific mechanism may be involved. Consistent findings indicate that boys have higher levels of externalising and delinquent behaviour than girls (Batstra, Neeleman & Hadders-Algra, 2003; Chandy, Blum & Resnick, 1996; Essex, et al., 2003), and externalising behaviour has been associated with school achievement (Beitchman & Young, 1997; Richards, et al., 1995). In addition, neighbourhood informal social control has been associated with early adolescents' mental health and behaviour (Drukker, et al., 2003). Thus, a more controlling environment may reduce the risk of escalation of externalizing tendencies, resulting in better school performance. Furthermore, another study reported that parental monitoring was higher in girls and in younger children (Raboteg-Saric, Rijavec & Brajsa-Zganec, 2001). It is possible that neighbourhood informal social control provides an alternative to parental control in boys.

Interaction socioeconomic deprivation by social capital

Previously, the proportion of young adult males who had not graduated was identified as the most important predictor of male achievement (Connell & Halpern-Felsher, 1997; Quane & Rankin, 1998). Therefore, we hypothesised that effects of socioeconomic deprivation were greatest in high social capital neighbourhoods, because in these neighbourhoods norms and values spread more easily. Residents of high social capital neighbourhoods may more easily

copy behaviour from their peers. This may result in lower investment in school in poor neighbourhoods, where young adult role models were school drop-outs, and higher investment in school in affluent neighbourhoods (Connell & Halpern-Felsher, 1997). However, there was no association between socioeconomic deprivation and school achievement, neither in high nor in low social capital neighbourhoods. Thus, findings supporting this mechanism were not replicated in Maastricht.

Individual level socioeconomic status

The results also showed that school achievement was associated with measures of individual socioeconomic status. This association between individual level socioeconomic status and (adult) educational level has been reported frequently (e.g. (Koivusilta, Arja & Andres, 2003; McCarthy, et al., 2003). Thus, while neighbourhood socioeconomic deprivation was not implicated in the suggested vicious circle of achievement and future opportunities, there is evidence for such a mechanism at the individual level. However, it is also possible that such familial clustering of academic achievement is not only the result of social factors but may also be determined by heredity or more likely heredity-environment interactions (Garcia Bacete & Rosel Remirez, 2001; Hudziak, et al., 2003; Schulte-Korne, et al., 1996).

Methodological issues

The strength of the present study is that individual measures and neighbourhood measures were collected separately, because perceptions of social capital are always biased by individual mental health status. The purpose of studying more distant mechanisms constituting objective social capital was realized by measuring social capital scale items in a group of informants that was different from the cohort investigated (Buka, et al., 2003).

Unfortunately, the CITO test is optional and some schools chose not to take it and, therefore, school achievement scores were obtained from only 23 of the 38 schools. In order to examine possible bias due to this selection, the group of children used in the present analyses was compared with the rest of the responders. Gender and grade retention were similar between both groups. The parents of the children used in the present analyses had somewhat higher educational and occupational status, but these differences were not statistically significant. Thus, children from the 23 schools appeared to be representative for all Maastricht children.

The present paper has some limitations. Firstly, although most children were aged 11 years, ten repeated a grade and, therefore, were somewhat older. Age was not included in the analyses because the older age and the lower performance of the older children (the reason why they repeated a grade) should result in similar test results as the 11-year olds. Analyses were repeated with grade retention as an extra confounder, and this yielded similar results.

Secondly, school level variance was only statistically significant in the empty model (neither neighbourhood nor individual variables in the model) and neighbourhood level variance was not statistically significant. Theoretically, variance at each level warrants including that level in the analyses (Snijders & Bosker, 1999). However, neighbourhood researchers tend to analyse neighbourhood effects, even when neighbourhood variation is low, and it is generally held that this is warranted (Raudenbush & Sampson, 1999).

Finally, the data set of the present paper is cross-sectional and, therefore, it is impossible to prove causality. Informal social control may impact on school achievement scores, but more intelligent boys may also contribute to higher levels of informal social control.

Previous analyses in Maastricht showed interaction effects between socioeconomic deprivation and residential instability (Drukker, Driessen, et al., 2004; Drukker, Kaplan & Van Os, in press). However, fitting of these interactions did not yield evidence for an interaction effect.

Implications
Eleven year old boys seemed to benefit from a controlling environment. If this result can be verified in longitudinal studies, municipal policies aimed at enhancing informal social control may be considered. A focus on the importance of compliance with and imposition of certain norms and values may be conducive to the development of those growing up in the neighbourhood environment.

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Appendix: translation of the Dutch informal social control and social cohesion&trust items

1) Informal Social Control (ISC)

What is the likelihood that your neighbours can be counted on to intervene in the following situations: (very likely, likely, neither likely nor unlikely, unlikely, very unlikely)

a. If neighbours throw out garbage on the street (added item)
b. If one of the houses constantly gives noise pollution (added item)
c. If children were skipping school and hanging out on the street corner (original item)
d. If children get into mischief, are being naughty (added item)
e. If children were spray-painting graffiti on a local building? (original item)
f. If children were showing disrespect to an adult? (original item)
g. If children were showing disrespect to an elderly person (added item)
h. If a fight broke out in front of their house? (original item)
i. If the fire station closest to their home was threatened with budget cuts (in Dutch not the fire station but the ambulance)
j. If someone is planning to open a sex club (added item)

ISC: all items included

2) Social Cohesion and Trust (SC&T)

How strongly do you agree or disagree with the following statements? (a five point Likert scale from strongly agree to strongly disagree)

a. People are willing to help their neighbours (original item)
b. This is a close-knit neighbourhood (original item)
c. People in this neighbourhood can be trusted (original item)
d. People in this neighbourhood generally don't get along with each other (original item)
e. People in this neighbourhood do not share the same values (original item)
f. Children in this neighbourhood are close-knit
g. Children in this neighbourhood are heading for trouble
h. Children in this neighbourhood play together a lot
i. This neighbourhood is unsafe for children (traffic)
j. I don't send my children to the neighbourhood school
k. There are many children in this neighbourhood which I don't want my child to play with

SC&T: items a-h, j-k

3.5 The wider social environment and changes in self-reported quality of life in the transition from late childhood to early adolescence

Background: The contribution of the neighbourhood environment to adolescents' quality of life and the course of these effects during the period of transition from childhood to early adolescence was examined.
Methods: A cohort of adolescents living in Maastricht (The Netherlands), with a mean age of 11.2 years at baseline and of 13.5 years at follow-up was followed. Adolescents who responded both at baseline and at follow-up were included in the analysis (n=475). Multilevel regression analyses estimated neighbourhood effects while controlling for individual-level effects. Neighbourhood-level socioeconomic and social capital variables, individual-level confounders, and baseline values of the outcome measures were included in the models.
Results: None of the neighbourhood factors was associated with changes in general health or mental health over the two-year period. However, two-year exposure to greater disparity between individual level socioeconomic status on the one hand and neighbourhood level of socioeconomic status on the other (e.g. high socioeconomic status adolescents living in deprived neighbourhoods and vice versa) negatively impacted on self-esteem and satisfaction.
Conclusions: The neighbourhood environment *per se* does not contribute to change in quality of life during the transition to early adolescence. However, adolescents living in families whose socioeconomic status deviates from the mean level of neighbourhood socioeconomic deprivation may be negatively affected.

Drukker, M., Kaplan, C. D., Schneiders, J., Feron, F. and Van Os, J. (submitted) 'The wider social environment and changes in self-reported quality of life in the transition from late childhood to early adolescence'

Full article is included in the CD-ROM, which is enclosed in the complete version of this PhD thesis (back flap)

The wider social environment and changes in self-reported quality of life in the transition from late childhood to early adolescence

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Abstract

***Background*:** The contribution of the neighbourhood environment to adolescents' quality of life and the course of these effects during the period of transition from childhood to early adolescence was examined.

***Methods*:** A cohort of adolescents living in Maastricht (The Netherlands), with a mean age of 11.2 years at baseline and of 13.5 years at follow-up was followed. Adolescents who responded both at baseline and at follow-up were included in the analysis (n=475). Multilevel regression analyses estimated neighbourhood effects while controlling for individual-level effects. Neighbourhood-level socioeconomic and social capital variables, individual-level confounders, and baseline values of the outcome measures were included in the models.

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***Conclusions*:** The neighbourhood environment per se does not contribute to change in quality of life during the transition to early adolescence. However, adolescents living in families whose socioeconomic status deviates from the mean level of neighbourhood socioeconomic deprivation may be negatively affected.

Key words: Social capital, Neighbourhood, Quality of life, Cohort study

Introduction

Previous cross-sectional research has demonstrated associations between neighbourhood factors and adolescent well-being and mental health.[1] However, in order to make causal interferences longitudinal studies are required. In addition, the time window over which neighbourhood impacts on development is unknown. Effects demonstrated in adolescence may be evidence of an exposure that originated in childhood. Alternatively, neighbourhood effects may impact cumulatively over the developmental course with effects increasing linearly with exposure time. Previously, a longitudinal study[2] reported increasing youth-reported behavioural problems (YSR) between the ages of 11 and 13 years in socioeconomically deprived neighbourhoods. Furthermore, a retrospective case-control study showed that neighbourhood socioeconomic deprivation (NSD) was associated with increased rates of children's mental health service use when neighbourhood social cohesion was low.[3]

NSD and social capital appear particularly important in relation to health-related quality of life and other health outcomes. NSD (low neighbourhood socioeconomic status) has been widely studied in children and adolescents.[1] However, although neighbourhood social capital has been identified as an important contextual factor in adults' health,[4, 5] studies on neighbourhood level social capital in adolescents are scarce.[6, 7] Social capital can be seen as the glue that holds society together.[5] It has been defined as "those features of social organisations that act as resources for individuals and facilitate collective action, e.g. high levels of interpersonal trust and norms of mutual aid and reciprocity".[4]

After controlling for individual-level confounders, baseline results of the cohort used in the current study showed that NSD and social capital were associated with children's general health and satisfaction.[6] Children's mental health was specifically associated with one aspect of social capital: the degree of informal social control.[6] Because independence and autonomy increase during adolescence with more time spent in the neighbourhood, increasing neighbourhood influences and decreasing family influences may be expected.[8, 9] Early adolescence (11-15 years) involves many life events and developmental tasks, such as changing school and joining (and leaving) multiple peer groups, which may result in larger variability in changes in quality of life over time. We, therefore, hypothesised that associations between neighbourhood environment and health related quality of life would not be static, and that changes in quality of life from age 11 years into early adolescence would be similarly linked to the neighbourhood environment.

Previous research hypothesised several interaction effects. Firstly, effects of NSD could be different for families of low socioeconomic status (SES) and affluent families.[6] Secondly, effects of NSD on child outcomes may be different in neighbourhoods with high and low social cohesion and trust.[3]

Methods

Research design

Maastricht is a small city located in the extreme south of the Netherlands (122 000 inhabitants) with a predominantly white population. The present study aimed to follow a cohort of adolescents living in the 36 Maastricht residential neighbourhoods and attending the same grade.[6] At baseline and follow-up, adolescents and their parents were asked to fill in a quality of life questionnaire that also included individual and family confounding variables. The present paper reports on the follow-up measurement two to three years after baseline (2002/2003).

Neighbourhood variables

The measure of NSD was based on various neighbourhood socioeconomic characteristics obtained from the Maastricht Statistics Department and Statistics Netherlands (CBS).[6] In order to assess social capital, approximately 200 inhabitants aged 20 to 65 years were randomly selected from each of 36 Maastricht neighbourhoods, using the municipal database (hereafter: community survey). These inhabitants received a questionnaire on social capital, which they were asked to send back. Social capital was measured using the two collective efficacy scales: informal social control (ISC) and social cohesion and trust (SC&T), developed by Sampson and colleagues.[7] The two sum scores were obtained from individual answers in a community survey and aggregated to neighbourhood level.[6] The ISC scale measures the willingness to intervene in hypothetical neighbourhood-threatening situations, for example in the case of children misbehaving. The SC&T scale measures bonds and trust among neighbourhood residents.

The three neighbourhood variables were standardized to mean zero and unity standard deviation. Higher scores indicated more NSD and lower levels of social capital.[6] Previous analyses revealed that NSD, ISC, and SC&T were highly but not perfectly correlated.[6]

Adolescents' health-related quality of life

Both baseline and follow-up questionnaires of adolescents consisted mainly of the Child Health Questionnaire (CHQ) child form (87 items).[10] The CHQ-subscales general health, mental health, and self-esteem were selected for the analyses.[6] Furthermore, items on satisfaction were added to the questionnaire and a satisfaction scale was constructed combining self-esteem and satisfaction items.[6] Because this scale was constructed in the same way as the original CHQ scales,[10] general health, mental health, self-esteem, and satisfaction scales could all range from 1 to 100 and were all positively scored, higher scores indicating better outcomes.

Individual-level variables

Occupational status was measured using the current or last profession of the parents, and scored according to the International SocioEconomic Index of occupational status ISEI-92.[11] Parent questionnaires also assessed the highest level of completed education. Family occupational and educational status were based on the parent with the highest score. In order to ensure control for family level processes, a variable measuring the quality of child-parent interaction at baseline was included in the models as the family-level equivalent of neighbourhood social capital. This variable, parental perceived difficulty (in child raising), was measured using the NOSIK (Nijmegen Parental Stress Index Short Version), a Dutch 25 item questionnaire (items such as "I have much more problems raising my child than expected", and "I notice that I am less able to take care of my child than expected").[12] Sum scores of the 11 items of the parent domain were used in the present analyses.

Statistical analysis

All analyses were performed using STATA (version 7/SE). Hierarchically structured data were subjected to multilevel regression analysis[13] in order to investigate neighbourhood effects while controlling for individual effects. Multilevel or hierarchical linear regression techniques are a variant of the more often used unilevel linear regression analyses and are ideally suited for analysis of clustered data, in this case consisting of multiple persons clustered within a single neighbourhood. The βs are the regression outcomes of the predictors in the multilevel model and can be interpreted identically to the estimates in the unilevel analyses.

Regression models analysing quality of life (general health, mental health, self-esteem, or satisfaction) included baseline quality of life, parental occupational status, parental educational status, parental welfare recipient status, single parent family status, child's gender, grade retention (age), and parental perceived difficulty (NOSIK). Occupational status, parental perceived difficulty, and parental educational status were entered as dummy variables in the equation, high occupational status, high educational status, and low perceived difficulty being the reference categories. Neighbourhood-level variables were NSD, ISC, or SC&T (included separately).

Two a priori interaction terms were added to the models: NSD * individual SES, and NSD * SC&T. When results suggested interaction, two methods were used to further clarify the dynamics of the interaction. (1) If one of the interacting variables was educational status, analyses were performed stratified by combined categories (university or higher vocational, higher secondary or intermediate vocational, lower secondary or elementary). (2) If SC&T was the interacting variable, the model including the interaction term was used to calculate effects of NSD for very low social cohesion and trust neighbourhoods (i.e. SC&T variable-2SD), low social cohesion and trust (i.e. SC&T variable-1SD), average social cohesion and trust (SC&T variable), high social cohesion and trust (SC&T variable+1SD), and very high social cohesion and trust (SC&T variable+2SD), respectively.

Results

Descriptives and correlations

Of the 1007 adolescents in the cohort, 598 responded at baseline (59%) and 703 (70%) at follow-up. Of all baseline respondents, 79% responded at follow-up and these adolescents were included in the present analysis (n=475). In 94%, address or neighbourhood was the same as at baseline. Adolescents' mean age was 11.2 years at baseline and 13.5 years at follow-up, and 52% was female. Generally, follow-up scores on the quality of life variables were lower than baseline scores (table 1), but baseline and follow-up scores were highly correlated (table 2).

Table 1: Descriptives: quality-of-life of the study sample at baseline and at follow-up.

	quality-of-life			
	general health	mental health	self-esteem	satisfaction
Baseline				
N	472	472	473	474
mean	79.9	82.9	81.0	80.0
standard deviation	15.1	11.4	11.9	11.0
range	23.8 - 100	23.4 - 100	28.8 - 100	32.3 - 100
Follow-up				
N	475	475	474	475
mean	77.4	78.4	75.2	69.1
standard deviation	14.7	12.5	11.9	11.9
range	23.3 - 100	28.3 - 100	32.7 - 100	31.3 - 99.0
Change				
N	472	472	472	474
mean	-2.5	-4.5	-5.9	-10.8
standard deviation	15.5	13.4	12.6	12.6
range	-44.2 - 49.6	-54.7 - 51.6	-50.0 - 42.3	-43.8 - 29.2

Table 2: Pearson correlations between quality-of-life variables at baseline and at follow-up.

	quality-of-life at follow-up			
	general health	mental health	self-esteem	satisfaction
quality-of-life at follow-up				
general health	1	0.49[1]	0.50[1]	0.44[1]
mental health		1	0.66[1]	0.60[1]
self-esteem			1	0.88[1]
quality-of-life at baseline				
general health	0.46[1]			
mental health		0.38[1]		
self-esteem			0.44[1]	
satisfaction				0.40[1]

[1] p<0.001

Associations between neighbourhood factors and changes in general and mental health

Neither crude analyses nor analyses controlling for confounders (see statistical analyses) showed large or statistically significant associations between neighbourhood factors and changes in general or mental health (data not presented).

Associations between neighbourhood variables and changes in self-esteem and satisfaction

Initial models of self-esteem showed suggestive interaction effects between (1) NSD and SC&T (p=0.13) and (2) NSD and parental educational status (p=0.11). NSD was associated

Table 3: Multilevel regression analysis: the association between neighbourhood socioeconomic deprivation (NSD) and changes in self-esteem, βs and 95% confidence intervals (CI)[1][2]

Parental educational status: University or higher vocational (n=173)		β	CI
very little cohesion and trust	NSD	-4.91	-13.9; 4.04
little cohesion and trust	NSD	-3.93	-11.7; 3.89
average cohesion and trust	NSD	-2.95	-10.1; 4.19
good cohesion and trust	NSD	-1.97	-9.00; 5.07
very good cohesion and trust	NSD	-0.99	-8.53; 6.56
Parental educational status: Higher secondary or intermediate vocational (n=128)			
very little cohesion and trust	NSD[3]	5.60	-2.16; 13.4
little cohesion and trust	NSD[3]	4.57	-2.40; 11.5
average cohesion and trust	NSD[3]	3.53	-3.38; 10.5
good cohesion and trust	NSD[3]	2.50	-5.14; 10.1
very good cohesion and trust	NSD[3]	1.46	-7.47; 10.4
Parental educational status: Lower secondary or elementary (n=118)			
very little cohesion and trust	NSD	9.85[4]	2.57; 17.1
little cohesion and trust	NSD	7.97[5]	1.79; 14.2
average cohesion and trust	NSD	6.09[5]	0.17; 12.0
good cohesion and trust	NSD	4.21	-2.38; 10.8
very good cohesion and trust	NSD	2.33	-5.64; 10.3

[1] Stratified by parental educational status and models analysed using 5 different levels of SC&T

[2] βs of NSD controlled for all confounders (baseline values, welfare recipient status, parental occupational status (5 categories), parental educational status (6 categories), parental perceived difficulty in child raising (5 categories), single parent family, gender, grade retention)

[3] Grade retention dropped due to collinearity

[4] p<0.01

[5] p<0.05

with a statistically significant positive change in self-esteem in adolescents with lower educated parents living in lower cohesion and trust neighbourhoods (table 3). Inversely, NSD was associated with a decrease in self-esteem in adolescents with higher educated parents. However, these latter associations were not statistically significant.

Additionally, the models showed suggestive interaction between NSD and parental educational status in the association with satisfaction (p=0.12). Again, compared to baseline, satisfaction of adolescents from higher educated parents was lower when living in a more deprived neighbourhood (table 4).

Table 4: Multilevel regression analysis: the association between neighbourhood socioeconomic deprivation (NSD) and changes in satisfaction, βs and 95% confidence intervals (CI)[12]

	β	CI
Parental educational status: University or higher vocational (n=173)		
NSD	-2.20[3]	-4.41; -0.04
Parental educational status: Higher secondary or intermediate vocational (n=128)		
NSD[4]	1.61	-0.73; 3.96
Parental educational status: Lower secondary or elementary (n=118)		
NSD	0.98	-1.09; 3.05

[1] Stratified by parental educational status

[2] βs of NSD controlled for all confounders (baseline values, welfare recipient status, parental occupational status (5 categories), parental educational status (6 categories), parental perceived difficulty in child raising (5 categories), single parent family, gender, grade retention)

[3] $p<0.05$

[4] Grade retention dropped due to collinearity

Individual-level variables and outcomes

Baseline values of general health, mental health, self-esteem, and satisfaction were all highly associated with their respective follow-up variables. All quality of life outcomes were lower in girls and in families with more perceived difficulty. Adolescents from single parent families reported lower levels of general health, self-esteem, and satisfaction, after controlling for baseline values. Lower parental educational status was negatively associated with changes in general health, albeit non-linearly - and it was positively associated with changes in satisfaction (data not presented).

Discussion

Results showed that neighbourhood factors did not predict changes in general health or mental health in the period of transition from late childhood to early adolescence. However, NSD was associated with a positive change in self-esteem and satisfaction in adolescents from lower educated parents, while it predicted a negative change in adolescents from higher educated parents. Thus, levels of self-esteem and satisfaction increased when family SES and NSD concurred. In a previous study, minority children living in a dissonant environment were reported to have lower levels of self-esteem than minority children from segregated but protected environments.[14] The current results suggest this type of contextual interaction may apply not only to ethnic group status, but also to SES itself.

The increasing self-esteem of adolescents from lower educated families in poor neighbourhoods may indicate that they were more likely to associate with specific peer groups of adolescents with similar family backgrounds. A similar mechanism may apply to adolescents from higher educated families living in affluent neighbourhoods. To our

knowledge, the present paper is the first that reports such specific associations and needs to be replicated. Under specific conditions of persistent poverty and lower levels of parental education, individuals may be more likely to join a specific form of youth peer group that has compensatory functions for deficits in the neighbourhood and at home. These specific youth peer groups have been generally termed as gangs.[15-17] Under conditions where low self-esteem might be expected, the gang intervenes as a group to provide a countervailing force that produces a new identity with an unexpected heightened sense of self-esteem.[18] This gang function has been extensively documented by intensive field and ethnographic studies in the United States,[19-21] but similar gangs do not exist in a small European city, like Maastricht. Current results suggest that psychological outcome and socioeconomic conditions for gang formation also exist in Maastricht. However, these 'gangs' do not perform large-scale illegal activities. Future research needs to study if European gangs are expressed or inhibited under different cultural and social policy conditions.

Furthermore, both the positive association in adolescents of lower educated parents and the negative association in adolescents of higher educated parents between NSD and self-esteem appeared stronger in neighbourhoods low in social cohesion and trust. Thus strong cohesion and trust mitigated effects of non-concurring family SES and NSD. This is in line with a previous study, showing a stronger association between NSD and children's mental health service use in neighbourhoods low in social cohesion and trust.[3]

Methodological issues

The strength of the present study is its longitudinal design that enables the prospective investigation of changes in quality of life in the transition to early adolescence. Furthermore, a principle objective of our methodology was to examine effects of neighbourhood variables that were obtained independently of the responding adolescents. Because perceptions of social capital are always biased by individual mental health status, it is difficult to disentangle cause and effect. The purpose of studying more distal mechanisms constituting objective social capital was realized by measuring social capital scale items in a group of informants that was different than the cohort investigated.[22]

The present paper has some limitations. Firstly, inclusion of educational status and occupational status guarantees satisfactory control for individual level SES in the Netherlands.[23] However, the possibility remains that residual confounding may have lead to spurious results at the neighbourhood level, because of omitted variable biases.[1] Families moving into poor or not moving out of poor neighbourhoods may differ from their peers although equally poor or affluent (e.g. in motivation, literacy etc).

Secondly, none of the models showed statistically significant variance at the neighbourhood level (σ_μ^2), and intra class correlations (ρ) were low. Theoretically, variance at each level warrants including that level in the analyses.[13] However, neighbourhood researchers tend to analyse neighbourhood effects, even when intra class correlations and neighbourhood variation are low, and it is generally held that this is warranted.[24] In addition, in line with low neighbourhood-level variance, results showed no main effects of any of the neighbourhood variables. This does not rule out hypothesized interaction effects: neighbourhood-level variables were associated with outcomes in subgroups of adolescents.

Associations between NSD, informal social control, and social cohesion and trust were so strong that collinearity problems would likely have arisen had these three variables been entered jointly in one regression model. Therefore, all neighbourhood variables were entered in the models separately, except when analysing interaction effects between two neighbourhood variables.

Finally, a previous study in another Dutch city on changes in behavioural problems between the age of 11 and 13 years, showed a statistically significant association between

NSD and only one of the six behaviour outcomes.[2] Because all changes in behaviour were in the expected direction, the authors proposed that a longer follow-up period could reveal statistically significant changes. A future data collection in the current cohort may reveal more associations between neighbourhood factors and changes in general and mental health, and associations with self-esteem and satisfaction could be replicated.

Policy Implications

The present study showed that NSD and social capital were associated with outcomes in specific subgroups of adolescents. Neighbourhood dynamics seemed to have put adolescents with non-concurring family SES at disadvantage. However, while results might suggest that further segregation of the neighbourhoods improves self-esteem and satisfaction in these adolescents, this must be weighed against a far more severe level of disadvantages, such as social isolation with the full range of negative outcomes that co-occur.

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Chapter 4

Mental health service use

4.1 The wider social environment and mental health service use

Objective Previous studies associating neighbourhood context with mental health service use typically included limited sets of confounders.
Method A data set including patients registered in a Case Register and population controls was subjected to multilevel analyses, including neighbourhood exposures and individual-level confounders. In addition, days of care consumption of the patients was addressed.
Results The association between socioeconomic deprivation and social capital on the one hand and mental health service use rates on the other could be attributed to individual-level differences. However, number of days of service consumption was higher in neighbourhoods with more informal social control. In residentially stable neighbourhoods only, socioeconomic deprivation was associated with lower levels of service consumption.
Conclusion Higher levels of social control may induce patients to remain in contact with mental health services. Furthermore, higher levels of deprivation in neighbourhoods with little population mobility may result in reduced expectations of recovery and/or increased tolerance.

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The wider social environment and mental health service use

Drukker M, Driessen G, Krabbendam L, van Os J. The wider social environment and mental health service use.
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Key words: residence characteristics; community networks; social class; social problems; informal social control; mental health services; population dynamics

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Introduction

Neighbourhood context has proved to be an important predictor in the study of both treated mental health (i.e. mental health service use) and self-reported mental health. However, previous contextual studies using individual level information on treated mental health all had some methodological flaws (1–5).

Socioeconomic deprivation or poverty is the neighbourhood factor that has been studied most, having effects over and above individual level socioeconomic status (6–8). In addition, interaction between residential instability (mobility) and socioeconomic deprivation has been shown (9, 10). In the latter studies, associations between socioeconomic deprivation on the one hand and psychological distress and quality of life on the other appeared to be stronger in neighbourhoods with lower levels of population mobility.

Recently, social capital has also been identified as a neighbourhood characteristic that is associated with various health and mental health outcomes (11–13). Kawachi et al. (14) defined social capital as 'those features of social organizations – such as networks of secondary associations, high levels of interpersonal trust and norms of mutual aid and reciprocity, which act as resources for individuals and facilitate collective action', using standard works on social capital (15, 16). The measurement relies largely on the subjective assessments of the residents of the neighbourhood social environment. For example, collective efficacy has been used to account for the process of social capital formation whereby the perceived level of cohesion and trust between neighbours is tied to their shared beliefs in their capability of collective action (17). Sampson and colleagues developed two collective efficacy scales: informal social control and social cohesion and trust (18). The first scale measures the willingness of neighbours to intervene in hypothetical neighbourhood-threatening situations, for example, in the case of children misbehaving or the opening of

a brothel in the street. The second scale measures bonds and trust among the residents of the neighbourhood.

Most previous neighbourhood studies all used indices of perceived health and mental health. However, studying treated mental health can provide information on the more serious and treated mental health problems, as opposed to subjective outcomes collected in population surveys. Case Register data are designed to study effects on treated mental health. In addition, although previous research included data on both individual and neighbourhood level (1, 2), Case Registers generally compile a limited set of demographic variables only and previous Case Register research compared the cases with the general population, stratified by age, gender, and marital status supplied by the local authorities, thus including individual level information of these three variables only (1, 4). Therefore, previous research on treated mental health probably was not able to fully disentangle individual and neighbourhood level effects. Including individual level equivalents of neighbourhood level factors is analytically critical. For example, when individual socioeconomic status is not included in the analyses, neighbourhood socioeconomic deprivation will serve as an (imperfect) proxy of individual level socioeconomic status.

Furthermore, both quantity and type of service consumption can be seen as indicators of level of severity of the mental illness of patients (19, 20) and, therefore, neighbourhoods with less favourable environments can be hypothesized to have higher levels of service consumption.

In the present study, data pertaining to the Maastricht Mental Health Case Register (MHCR) as described by Driessen and colleagues (2) and data of a population control sample were used. These data were merged with proxies of individual level socioeconomic status, at postal code level. Our main neighbourhood level variables were socioeconomic deprivation, residential instability, informal social control, and social cohesion and trust.

Aim of the study

The following issues were investigated:

1. Are the four neighbourhood variables associated with mental health service use rates (a case–control design)?
2. Are neighbourhood variables associated with quantity (days in contact) and type of service consumption of the cases?

In addition, based on previous research, we hypothesized an interaction effect between socioeconomic deprivation and residential instability.

Material and methods

Maastricht is a relatively small Dutch city. Twenty per cent of the population are first or second generation immigrants, but only 6% are of non-Western origin (21). The Maastricht population consists of 122 000 inhabitants living in 36 residential neighbourhoods, having between 300 and 8500 inhabitants (all ages). The boundaries of these neighbourhoods follow main roads and are ecologically meaningful. One of the 36 neighbourhoods was excluded, because data on socioeconomic deprivation and residential instability were not available.

The present paper uses both individual level and neighbourhood level data. Individual level data were obtained from MHCR and population controls.

Cumulative incidence and mental health service consumption

Since 1981, the MHCR has cumulatively collected data on all mental health contacts in Maastricht and surrounding areas (i.e. contacts with psychiatric hospital, community mental health centre, psychiatric department of university hospital, community psychiatric emergency outreach team, psychogeriatric nursing homes, sheltered housing, child psychiatric services, services for the mentally impaired, or alcohol and drug misuse services). Collected data were chronically ordered per patient using a probability linkage procedure involving five variables: gender, date of birth, first letter of the (maiden) name, place of birth, place of residence. In addition, individual demographic (gender, age, marital status, education, employment, and social situation) and diagnostic data (e.g. schizophrenia, alcohol addiction, affective disorders) of the patients were registered. For the present analyses all patients (all diagnoses) living in the city of Maastricht were selected and, therefore, any effect of the distance to psychiatric services was minimized, as within the city of Maastricht all distances can easily be covered by bicycle. Mental health services are covered by a national insurance and a general practitioner referral was not necessary for attending a community mental health centre during the period used in this report. Long-term inpatients having no other address than the address of the psychiatric hospital and residents of sheltered housing projects were excluded from all analyses.

In order to provide descriptive statistics per neighbourhood, neighbourhood level 10-year cumulative incidence (1993–2002) of all cases aged 15 years and over were determined. Incident cases were individuals who did not have (known) contacts with mental health services for at least 5 years. The mean size of the population, the denominator of the incidence fraction, was estimated by averaging the population sizes at 01-01-1995 and at 01-01-2001 (≥15 years) (21).

In order to analyse service use rates, all incident cases (all diagnoses, persons aged between 20 and 65 years) in the year 2000, were compared with a population control group (case–control design, see below).

In addition, all incident cases, aged between 20 and 65 years at first contact, between 01-01-1988 and 31-12-1997, were followed for 5 years to determine service consumption: hospitalized days (intra), day care (semi), and out-patient contacts (extra). Every out-patient contact and every day in day care or hospital was counted as one unit of care (hereafter 'day'). These data were used to calculate the total care consumption (total = intra + semi + extra). Because all service consumption variables were highly skewed to the left, the scores were transformed using the natural logarithmic function.

Case–control design; service use rates

Approximately 200 inhabitants aged 20–65 years were randomly selected from each neighbourhood, using the municipal database (hereafter 'community survey'). These inhabitants received a questionnaire, which they were asked to send back. Forty-eight per cent of the selected sample responded ($n = 3469$). The questionnaire recorded (amongst other questions) the same demographic data as recorded in the MHCR, making the group of respondents of the community survey suitable as a control group, although the population had not been specifically selected for this purpose (secondary analyses). This resulted in an unmatched case–control design. In addition, the questionnaire included items on social capital (see below).

Because controls were aged between 20 and 65 years, MHCR cases in other age groups were excluded from the analyses.

Neighbourhood socioeconomic deprivation and residential instability

The city of Maastricht Statistics Department and Statistics Netherlands (CBS) supplied all available objective neighbourhood data that can be used as estimators of socioeconomic characteristics. To summarize these data an exploratory factor analysis (principal factors without rotation) was carried out (22). The two identified factors, hereafter called 'socioeconomic deprivation' and 'residential instability', explained 70.0% of the total variance. Single parent families, ethnicity, non-voters, unemployment, unemployment more than 1 year, social security, social security more than 3 years, mean income, mean income for persons employed 52 weeks a year, percentages high and low incomes, and percentage economically inactives loaded on socioeconomic deprivation. Single persons and various mobility variables (departure, settlement, mobility within neighbourhoods, total mobility, mobility balance) loaded on residential instability. Factor scores were calculated for both the socioeconomic deprivation and residential instability constructs, yielding continuous variables with mean 0 and unity standard deviation. Higher scores indicated more socioeconomic deprivation and more residential instability.

Social capital

The above-mentioned community survey that was used to select controls, originally had served to collect neighbourhood social capital in all neighbourhoods (22). Social capital was measured using the two collective efficacy scales: informal social control (hereafter 'ISC') and social cohesion and trust (hereafter 'SC&T'), developed by Sampson and colleagues (12). Both scales were translated into Dutch and back-translated into English. In order to adapt the ISC scale to the Dutch situation, 5-items corresponding to typical Dutch concerns were added. The ISC scale measures the willingness to intervene in hypothetical neighbourhood-threatening situations, for example, in the case of children misbehaving or the opening of a brothel in the street. This scale is conceived in such a way that respondents are independent informants about their neighbours' willingness to intervene. The SC&T scale measures bonds and trust among the residents of the neighbourhood (using statements-like: people are willing to help their neighbours. This is a close-knit neighbourhood). Sum scores were constructed of both collective efficacy scales, higher scores indicating lower levels of informal social control and lower levels of social cohesion and trust. Before analyses sum scores were standardized to unity standard deviation. Previous analyses revealed that neighbourhood socioeconomic deprivation, ISC, and SC&T were highly, but not perfectly correlated (22).

Individual level socioeconomic status

Although individual demographic variables, such as marital status, education, employment, and social situation are in part associated with individual socioeconomic status, the MHCR-data do not include measures specifically to assess socioeconomic status. Therefore, a proxy individual level socioeconomic status variable was obtained using postal code house price registrations. Postal code areas (as used by the postal services) are defined by six characters, and the Maastricht residential neighbourhoods each contain between 27 and 186 postal codes (mean 82). To estimate postal code socioeconomic status, house prices per postal code between 1998 and 2002 were collected from the web site of the Dutch land registry organization. The prices per year were divided by the mean price per year (to control for increase of the house prices over the years) and these were used as an index of postal code socioeconomic status. However, this index was not available from postal codes with rented houses only (43% of all residential postal codes). In order to obtain one proxy for both owner-occupied and rented houses, house price index was estimated in postal codes with rented houses only using a regression model with all available data on rented houses, such as rent of the houses, mean number of floors, and percentages of houses with a garden.

Statistical analysis

Data were grouped according to neighbourhood and were, in statistical terms, part of a multilevel structure with level-one units (individuals) structured into level-two units (neighbourhoods). These hierarchically structured data were subjected to multilevel regression analysis (23) in order to investigate neighbourhood effects while controlling for individual effects. Multilevel or hierarchical linear and logistic modelling techniques are a variant of the more often used unilevel linear and logistic regression analyses and are ideally suited for the analysis of clustered data, in this case consisting of multiple persons clustered within a single neighbourhood. The βs (linear) and the odds ratios (logistic) are the regression outcomes of the predictors in the multilevel model and can be interpreted identically to the estimates in the unilevel analyses.

First, mental health service use rates were addressed. The case–control design data were subjected to multilevel logistic regression analyses using MLwiN (24) [second order Penalised Quasi Likelihood (PQL)]. Because we sampled the same number of controls in every neighbourhood, data of controls were weighted to reflect the distribution of the general population per neighbourhood. Analyses were controlled for gender, age group (20–30; 30–40; 40–50; 50–65), marital status, educational status (high; low), employment status (employed; unemployed), social situation (not single, single, single parent or other), individual socioeconomic status index (in five categories), and an indicator whether this index was derived from owner-occupied or rented houses (buy/rent). This last variable was included because individual level socioeconomic status was estimated in postal codes with rented houses only. All categorical variables were recoded into dummies with the low-risk category being the reference (aged 20–30, married, high education, employed, not single, high socioeconomic status). Missing values of marital status, education, and living situation were entered in the model as extra categories, so that subjects having a missing value were not excluded from the analyses. This resulted in the following fixed effects multilevel logistic regression model:

$$\begin{aligned}\ln(\text{odds}) = {} & \beta_0 + \beta_1 \text{ neighbourhood variable}_j \\ & + \beta_2 \text{ gender}_{ij} + \beta_{3-5}\text{age dummy}(1-3)_{ij} \\ & + \beta_{6-9} \text{ marital status}(1-4)_{ij} \\ & + \beta_{10-11}\text{education dummy}(1-2)_{ij} \\ & + \beta_{12-13} \text{ employment dummy}(1-2)_{ij} \\ & + \beta_{14-16} \text{ living situation dummy}(1-3)_{ij} \\ & + \beta_{17-20} \text{ socioeconomic status} \\ & \quad \text{dummy}(1-4)_{ij} \\ & + \beta_{21}\text{buy/rent}_{ij} + \mu_{\text{j}}\end{aligned}$$

In which, ln(odds) was the odd of being a case and the neighbourhood variable was socioeconomic deprivation, residential instability, informal social control, or social cohesion and trust. In addition, an *a priori* interaction term: socioeconomic deprivation by residential instability was analysed (i.e. $\beta_0 + \beta_1$ socioeconomic deprivation$_j$ + β_2 residential instability$_j$ + β_3 socioeconomic deprivation × residential instability$_j$ + see above).

Second, analyses on number of days of care consumption in the patients were performed using STATA (version 7) (25). All above-described confounders were again entered in the models. This resulted in the following fixed effects multilevel linear regression model (maximum likelihood method):

$$\begin{aligned}\text{Outcome} = {} & \beta_0 + \beta_1 \text{neighbourhood variable}_j \\ & + \beta_2 \text{gender}_{ij} + \beta_{3-5} \text{age dummy}(1-3)_{ij} \\ & + \beta_{6-9} \text{marital status}(1-4)_{ij} \\ & + \beta_{10-11} \text{education dummy}(1-2)_{ij} \\ & + \beta_{12-13} \text{employment dummy}(1-2)_{ij} \\ & + \beta_{14-16} \text{living situation dummy}(1-3)_{ij} \\ & + \beta_{17-20} \text{socioeconomic status dummy}(1-4)_{ij} \\ & + \beta_{21} \text{buy/rent}_{ij} + \epsilon_{ij} + \mu_j\end{aligned}$$

In which the outcome was the logarithmic function of intramural days, extramural days, or total days in care, and the multiple error terms reflect residual variation at each level: individual (ϵ_{ij}) and neighbourhood (μ_j). Again, a model including the interaction term 'socioeconomic deprivation × residential instability' was constructed.

Results

Cumulative incidence and neighbourhood variables

Of all Maastricht inhabitants aged 15 years and over, 13.6% had had contact with any mental health institution (any diagnosis) in the last 10 years (1993–2002). The cumulative incidence per neighbourhood ranged between 11.5 and 20.1%. Figures 1–3 show variation in neighbourhood socioeconomic deprivation, informal social control and neighbourhood 10-year cumulative incidence rates, respectively. Neighbourhood socioeconomic deprivation was correlated with informal social control (Pearson correlation: 0.65, $P < 0.001$) and social cohesion and trust (Pearson correlation: 0.89, $P < 0.001$). In addition, informal social control and social cohesion and trust were correlated (Pearson correlation: 0.68, $P < 0.001$). Residential instability was only correlated with social cohesion and trust (Pearson correlation: 0.36, $P < 0.05$).

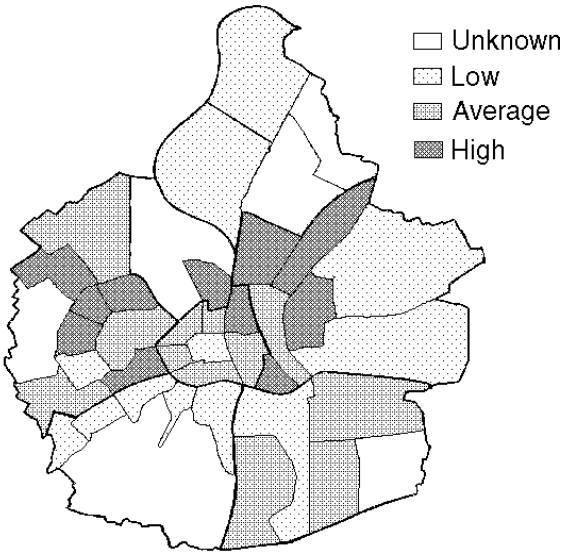

Fig. 1. Neighbourhood variation in socioeconomic deprivation.

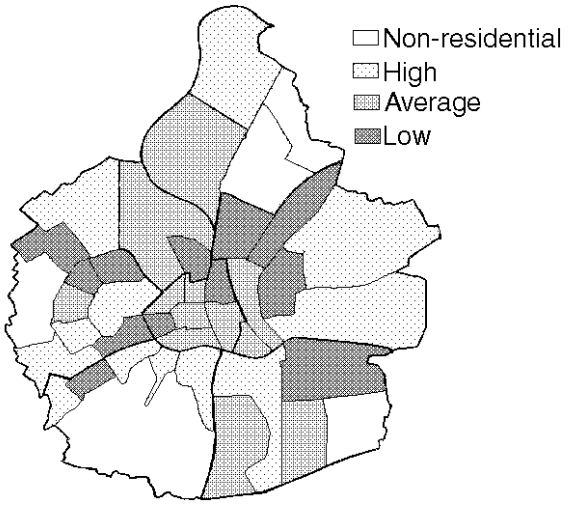

Fig. 2. Neighbourhood variation in informal social control (ISC).

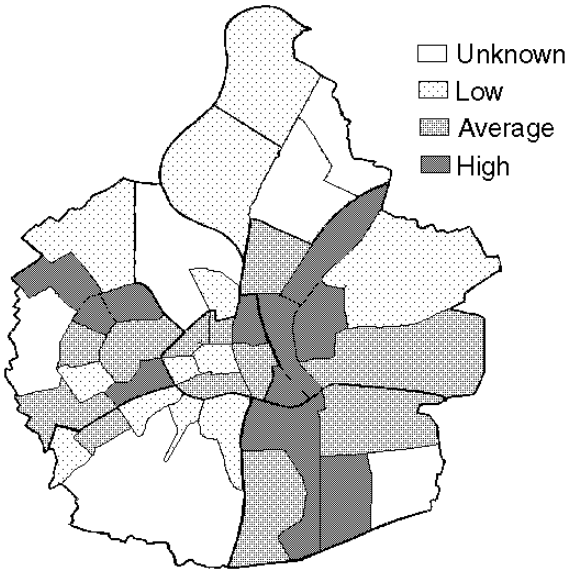

Fig. 3. Neighbourhood variation in incidence rates (all diagnoses).

Service use rates: case–control design

Table 1 presents descriptives of cases and controls. All neighbourhood variables were associated with

Table 1. Description of individual level variables in cases and controls (controls weighted to reflect distribution of the populations per neighbourhood)

	Cases (2000) (%)	Weighted controls (%)
Gender		
Female	539 (59.3)	1493 (55.8)
Male	370 (40.7)	1185 (44.2)
Age group (year)		
20–30	252 (27.7)	593 (22.1)
30–40	262 (28.8)	604 (22.5)
40–50	208 (22.9)	655 (24.4)
50–65	187 (20.6)	829 (30.9)
Marital status		
Married	329 (42.1)	1897 (72.0)
Divorced	136 (17.4)	142 (5.4)
Single (never married)	295 (37.7)	540 (20.5)
Widow/widower	22 (2.8)	55 (2.1)
Education		
Low	226 (24.9)	726 (27.1)
High	392 (43.1)	1673 (62.4)
Employment		
Employed	406 (44.7)	2190 (81.7)
Unemployed	241 (26.5)	286 (10.7)
Social situation		
Family	366 (40.3)	1852 (69.1)
Single	224 (24.6)	449 (16.8)
Other	69 (7.6)	110 (4.1)
Postal code socioeconomic status		
Low	221 (24.3)	522 (19.5)
Low medium	219 (24.1)	581 (21.7)
Medium	205 (22.6)	501 (18.7)
High medium	155 (17.1)	584 (21.8)
High	109 (12.0)	491 (18.3)
Total	909 (100)	2680 (100)
	Cases (1988–1997) Mean (SD)	
Days of service consumption		
Intramural	9.9 (81.9)	
Extramural	21.0 (33.3)	
Total	43.4 (148.9)	
Total	13 887	

Table 2. Odds ratio (OR) and 95% confidence intervals (CI) of mental health service use; multilevel logistic regression

$n = 3411$	OR (95% CI)
A Crude	
Socioeconomic deprivation	1.22 (1.10–1.35)***
Residential instability	1.11 (1.01–1.23)*
Informal social control†	1.16 (1.03–1.30)*
Social cohesion and trust†	1.22 (1.11–1.35)***
B Individual variables only‡	
Marital status	
Married (reference)	1
Divorced	6.96 (3.40–14.26)***
Single	4.10 (2.22–7.57)***
Widow/widower	3.44 (1.79–6.62)***
Low education	1.10 (0.86–1.39)
Unemployed	4.66 (3.83–5.69)***
Social situation	
Family or partner (reference)	1
Single	0.62 (0.35–1.10)
Other	0.72 (0.39–1.31)
Postal code socioeconomic status	
High (reference)	1
Low	0.94 (0.60–1.49)
Low medium	0.99 (0.65–1.49)
Medium	1.12 (0.73–1.71)
Higher medium	0.78 (0.52–1.18)
Buy or rent	0.69 (0.54–0.87)**
Neighbourhood variation (σ_μ^2)	0.04
Intra class correlation (ρ)	0.04
C Final models†	
Socioeconomic deprivation	0.97 (0.84–1.12)
Residential instability	1.08 (0.94–1.25)
Informal social control†	0.99 (0.87–1.12)
Social cohesion and trust†	0.98 (0.86–1.13)

***$P < 0.001$, ** $P < 0.01$, * $P < 0.05$.

†Standardized before analyses (SD = 1).

‡Including the individual level variables: gender, age (in 10-year groups), marital status (including a category for the missing values), education (idem), employment (idem), social situation (family or partner, single, other, missing), postal code socioeconomic status, and buy/rent.

mental health service use (Table 2, section A), in that service use rates were higher in more deprived neighbourhoods, more unstable neighbourhoods and in neighbourhoods with lower levels of social capital (i.e. higher scores on ISC and SC&T variables). However, after controlling for individual level demographic variables and socioeconomic status the associations disappeared (Table 2, section C). Not being married and being unemployed were strongly associated with mental health service use rates, while postal code socioeconomic status was not. There was no interaction between socioeconomic deprivation and residential instability.

Days of care consumption of cases

After controlling for individual level confounders, the association between lower informal social control (i.e. higher scores on the ISC variable) on the one hand and fewer total days of care on the other remained, and the association between ISC and extramural days was statistically imprecise by conventional alpha (Table 3, section C). After controlling for confounders, there were no associations between any of the neighbourhood variables and intramural days.

The model analysing extramural days showed interaction between socioeconomic deprivation and residential instability (Table 3, section D). In addition, the model analysing total care consumption was suggestive for interaction, but failed to reach statistical significance ($P = 0.13$). The dynamics of the interaction were further clarified by calculating βs of socioeconomic deprivation for residentially unstable neighbourhoods (i.e. average − 1 SD), average neighbourhoods (average), stable neighbourhoods (i.e. average + 1 SD), and very stable neighbourhoods (i.e. average + 2 SD), using the models of extramural and total care consumption, described in Table 3 (section D).

Table 3. Associations between neighbourhood variables and care consumption (in days) of cases; multilevel linear regression, βs and 95% confidence intervals (CI)

	Intramural days (CI)	Extramural days (CI)	Total care consumption (CI)
A crude			
Socioeconomic deprivation	−0.11 (−0.23 to 0.002)	−0.06** (−0.10 to −0.02)	−0.06** (−0.10 to −0.02)
Residential instability	−0.01 (−0.15 to 0.13)	0.03 (−0.02 to 0.08)	0.04 (−0.01 to 0.09)
Informal social control (ISC)†	−0.12 (−0.24 to 0.007)	−0.08*** (−0.12 to −0.05)	−0.08*** (−0.12 to −0.04)
Social cohesion and trust (SC&T)†	−0.10 (−0.22 to 0.01)	−0.05* (−0.09 to −0.01)	−0.05* (−0.09 to −0.004)
B Confounders only‡			
Marital status			
Married (reference)	0	0	0
Single	0.16 (−0.26 to 0.57)	−0.05 (−0.13 to −0.03)	−0.03** (−0.12 to 0.06)
Divorced	−0.39* (−0.77 to −0.01)	−0.09* (−0.18 to −0.007)	−0.13** (−0.23 to −0.04)
Widow	−0.01 (−0.60 to 0.57)	−0.05 (−0.23 to −0.12)	0.00 (−0.19 to 0.19)
Unknown	−0.13 (−1.45 to 1.20)	0.16** (0.04 to 0.28)	0.14* (0.01 to 0.27)
Employment			
Employed (reference)	0	0	0
Unemployed	0.43** (0.15 to 0.72)	0.17*** (0.10 to 0.24)	0.35*** (0.28 to 0.42)
Unknown	1.20** (0.30 to 2.09)	−0.25*** (−0.35 to −0.14)	−0.24*** (−0.35 to −0.12)
Social situation			
Family/partner (reference)	0	0	0
Single	0.30 (−0.11 to 0.70)	0.22*** (0.15 to 0.30)	0.34*** (0.25 to 0.43)
Other	0.54** (0.16 to 0.92)	0.48*** (0.37 to 0.59)	0.90*** (0.78 to 1.02)
Unknown	−1.70** (−2.71 to −0.70)	0.01 (−0.09 to 0.12)	0.01 (−0.11 to 0.12)
Education			
High (reference)	0	0	0
Low	−0.39** (−0.66 to −0.12)	−0.32*** (−0.39 to −0.26)	−0.34*** (−0.41 to −0.27)
Unknown	−0.74** (−1.20 to −0.27)	−0.47*** (−0.57 to −0.37)	−0.48*** (−0.59 to −0.38)
Postal code socioeconomic status			
High (reference)	0	0	0
Low	−0.11 (−0.53 to 0.31)	0.00 (−0.09 to 0.09)	−0.01 (−0.11 to 0.09)
Low medium	−0.12 (−0.54 to 0.30)	−0.03 (−0.12 to 0.07)	−0.05 (−0.15 to 0.06)
Medium	−0.01 (−0.44 to 0.42)	−0.03 (−0.12 to 0.06)	−0.02 (−0.12 to 0.07)
High medium	−0.12 (−0.53 to 0.30)	−0.00 (−0.09 to 0.09)	0.02 (−0.07 to 0.12)
Buy/rent	−0.08 (−0.35 to 0.19)	0.01 (−0.05 to 0.07)	−0.01 (−0.08 to 0.06)
Neighbourhood variation (σ^2_μ)	0	0.08**	0.08**
Intra class correlation (ρ)	0	0.0035	0.0029
C Neighbourhood variables controlled for confounders			
Socioeconomic deprivation	0.01 (−0.14 to 0.17)	−0.02 (−0.07 to 0.02)	−0.04 (−0.08 to 0.008)
Residential instability	−0.13 (−0.34 to 0.08)	0.00 (−0.05 to 0.06)	−0.02 (−0.07 to 0.04)
ISC†	−0.07 (−0.23 to 0.10)	−0.04 (−0.08 to 0.0009)	−0.06** (−0.10 to −0.02)
SC&T†	0.00 (−0.15 to 0.16)	−0.02 (−0.06 to 0.03)	−0.04 (−0.08 to 0.01)
D interaction between socioeconomic deprivation and residential instability			
Socioeconomic deprivation	0.04 (−0.16 to 0.25)	0.01 (−0.04 to 0.06)	−0.01 (−0.07 to 0.04)
Residential instability	−0.12 (−0.34 to 0.09)	0.03 (−0.03 to 0.08)	0.00 (−0.05 to 0.06)
Deprivation × residential instability	0.10	0.10*	0.08

***$P < 0.001$, ** $P < 0.01$, *$P < 0.05$.

†Standardized before analyses (SD = 1).

‡Including the individual level variables: gender, age (in 10-year groups), marital status (including a category for the missing values), education (idem), employment (idem), social situation (family or partner, single, other, missing), postal code socioeconomic status, and buy/rent.

Cases living in socioeconomically deprived but residentially stable or very stable neighbourhoods used fewer days of care consumption, while there was no association in average or unstable neighbourhoods (Table 4).

Cases who were unemployed had higher levels of service consumption, while low educational status was associated with lower levels of service consumption (all four measures; Table 3, section B). In addition, cases living alone (social situation: single) had higher levels of extramural and total service consumption.

Discussion

Mental health care use rates

Crude analyses showed that all neighbourhood factors were associated with service use rates. Rates were about 10–20% higher in neighbourhoods with less favourable environments (socioeconomically deprived or lower levels of social capital). However, effects could be attributed to individual level demographic and socioeconomic factors.

Previous Case Register studies did show associations between neighbourhood socioeconomic

Table 4. Associations between neighbourhood socioeconomic deprivation and extramural service consumption in neighbourhoods with various levels of stability [βs and 95% confidence intervals (CI)]

	Extramural days (CI)	Total care consumption (CI)
Unstable neighbourhoods (i.e. average − 1 SD)	0.11 (−0.02 to 0.24)	0.07 (−0.07 to 0.21)
Average neighbourhoods	0.01 (−0.04 to 0.06)	−0.01 (−0.07 to 0.04)
Stable neighbourhoods (i.e. average + 1 SD)	−0.09* (−0.17 to −0.01)	−0.09* (−0.18 to −0.01)
Very stable neighbourhoods (i.e. average + 2 SD)	−0.20* (−0.37 to −0.02)	−0.17 (−0.35 to 0.01)

*$P < 0.05$.

deprivation on the one hand, and the incidence of treated mental health and the incidence of psychosis on the other (1–3, 5). However, these Case Register studies included limited sets of individual data. On the contrary, however, most other previous multilevel studies did report neighbourhood effects of socioeconomic deprivation on perceptions of health and mental health after including individual level confounders. Socioeconomic deprivation was associated with self-reported health (26), self-reported mental health (7), child and adolescent wellbeing (6), and quality of life (27). Only one study reported that effects on mental health (GHQ) were mostly attributable to individual level socioeconomic status (28). Furthermore, an overview on social capital and mental health also reported evidence for an association between social capital and mental health (13). However, the included studies were diverse, and social capital was not measured in a uniform fashion and the authors recommended further study.

Thus, in general, the studies including all important confounders focused on subjective indicators of population health and mental health, which may be more sensitive to the influence of neighbourhood level variables. In addition, neighbourhood effects on mental health may be different for subgroups such as patients with psychosis.

Number of days of service consumption

Service consumption levels (out-patient and total) of patients living in neighbourhoods with less favourable profiles were lower. In particular, the association between lower levels of informal social control and lower number of days of total care consumption was strong and highly statistically significant after controlling for individual level demographic and socioeconomic variables, while the association between lower levels of informal social control and lower levels of out-patient service consumption was statistically imprecise by conventional alpha. In addition, neighbourhood socioeconomic deprivation was associated with lower levels of out-patient and total care consumption in residentially stable and very stable neighbourhoods only (see below).

The association between neighbourhood factors and the number of days of service consumption has not been studied before. However, a previous MHCR analysis stratified service use rates by tertiles of extramural (out-patient) service consumption (2). Service consumption was obtained by following all cases that were incident between 1991 and 1995 for 5 years (2). Because in the present study, all incident cases between 1988 and 1997 were followed for 5 years, periods of both analyses overlap. Driessen et al. reported that the association between socioeconomic deprivation and incidence rates was strongest when only cases in the lowest tertile of extramural service consumption were included, and somewhat weaker when only cases in the highest tertile were included. Thus, both previous MHCR analyses (2) and the present results indicate that cases with lower levels of (out-patient) service consumption are over-represented in more deprived neighbourhoods.

This previous MHCR analysis also reported higher incidence of intramural service consumption in socioeconomically deprived neighbourhoods (2), and a substitution of care mechanism has been proposed, in that cases living in affluent neighbourhoods were treated in out-patient facilities, while cases having similar psychiatric problems living in deprived neighbourhoods were more often hospitalized. Because the present analyses showed no associations between socioeconomic deprivation and number of days of hospitalization, we may conclude that whether or not substitution of care plays a role in socioeconomically deprived neighbourhoods, it has no effect on the number of days of hospitalization.

Interaction effect socioeconomic deprivation by residential instability

Our results showed larger associations between socioeconomic deprivation and out-patient care consumption in residentially stable neighbourhoods, and the model of total service consumption was also suggestive for interaction. Previous research also revealed larger effects in stable neighbourhoods. Thus, in stable neighbourhoods, socioeconomic deprivation was significantly asso-

ciated with higher levels of psychological distress and lower levels of quality of life respectively, whereas no such effects were found in unstable neighbourhoods (9, 10). Ross et al. (9) invoked a social isolation perspective according to which neighbourhood socioeconomic deprivation in poor stable neighbourhoods may be more distressing.

The present results indicate that patients living in stable neighbourhoods are more affected by socioeconomic deprivation, resulting in lower care consumption. Thus, higher levels of deprivation in neighbourhoods with little population mobility may result in reduced expectations of recovery and/or increased tolerance for mental ill-health and, by consequence, service consumption. This is in line with the suggestion that residents of poor stable neighbourhoods are feeling more trapped and powerless in a hopeless situation as formulated by Ross et al. (9).

Individual level socioeconomic status

No associations with postal code socioeconomic status were found in final models. However, crude analyses did show associations between postal code socioeconomic status and all outcomes. Thus, as expected, postal code socioeconomic status is associated with mental health service use rates and with care consumption days, but the individual level demographic variables related to socioeconomic status appeared to explain all variation in our models.

Mechanisms

Quantity of service consumption was studied as an indicator of seriousness of mental health problems and residents of more deprived neighbourhoods and neighbourhoods lower in social capital were expected to have higher levels of service consumption. Because effects in the opposite direction were found, this postulation was refuted. Instead, several mechanisms may *post hoc* be invoked to explain the present findings. First, individual level mechanisms may work at neighbourhood level, for example, because mental health professionals may estimate the patient's social class based on the neighbourhood they live in. Thus, the findings on social deprivation in residentially stable neighbourhoods may reflect a social class mismatch between mental health professionals and patients in the poorest neighbourhoods with low population turnover, resulting in less effective care. This is in line with previous research on the individual level, which showed that individuals differing in socioeconomic status (or educational status) had a different pattern of care consumption (29, 30). Second, it is possible that non-psychiatric health professionals, such as general practitioners and social workers, are more active in deprived neighbourhoods, or that the practice of prescribing psychotropic medications is different in these neighbourhoods. This could all result in fewer contacts with mental health services in stably deprived neighbourhoods. With respect to informal social control, more specific mechanisms can be invoked. For example, higher service consumption in neighbourhoods high in informal social control may be the result of interventions by neighbours, because residents of neighbourhoods with higher levels of social control may strive after greater levels of resolution of psychiatric disorder in patients living in the area, and by consequence generate higher levels of service consumption before community re-integration may be attempted.

Methodological issues

Previous neighbourhood social capital studies collected data on neighbourhood measures and individual measures, separately (22, 31). This was analytically critical because the objective of the researchers was not to study perceived social capital of the respondents, but rather more distant mechanisms of more objective social capital (31). In the present paper, the healthy control group provided information on neighbourhood level social capital as well. However, because controls only were informants on social capital the information is independent on the mental illness rate in the sample and the validity of the design is similar to the validity of two completely independent data collections.

For the first research question we switched to MLwiN because STATA has no routines to handle different weights within one macro level unit (controls were weighted to reflect the distribution of neighbourhoods, and cases all had a weight of 1). The MLwiN multilevel logistic regression procedure can model four different estimation methods. We chose second order PQL, because this method has been reported to produce unbiased estimates (32, 33).

The present paper has some methodological limitations. Firstly, incident cases were defined as the persons that did not have (known) contacts with mental health services for at least 5 years. Therefore, patients been in care somewhere outside the region who recently moved to the city of Maastricht were wrongfully marked as incident

cases. This could have resulted in a slight overestimation of the incidence rates in all neighbourhoods. In addition, new Maastricht residents are more likely to settle in a neighbourhood with a higher residential turnover. However, it is unlikely that results are substantially biased, because migration rates are relatively low. In 2000, 5% of the population were new residents of the city of Maastricht. Since approximately one-fifth (34) of Maastricht new residents originate from Maastricht surrounding areas, the population, which could have been wrongfully marked as incident cases, was approximately 4%.

Secondly, the response rate in the community survey (healthy controls) was below 50%, and we may assume that response is associated with socioeconomic status (22). However, it is unlikely that this has substantially influenced the associations of the neighbourhood factors in the case–control analysis. First, crude results of the neighbourhood level variables were not affected by the response rate because of the applied weight factor. Secondly, analyses were repeated using another weight factor in which unemployed and lower educated controls were overweighted to control for under-report in these groups. These analyses yielded similar results.

Thirdly, individual level socioeconomic status was estimated using a proxy at postal code level. As described in the Introduction, the reliability of a proxy for an individual level variable obtained from an aggregated level is generally lower than the reliability of an actual individual level variable. However, because postal code areas are much smaller than neighbourhoods any bias resulting from this procedure would be negligible. Inclusion of individual measures related to the concept of socioeconomic status, such as employment, education, social situation, and marital status, further strengthened the analyses. In addition, postal code socioeconomic status was based on data on the house price index in postal codes with owner-occupied houses. This index was not available in postal codes with rented houses only and was, therefore, estimated (see Methods). To assess whether this estimation procedure could have biased the results, we repeated all analyses with (1) an indicator of socioeconomic status based on owner-occupied houses only and (2) indicators of socioeconomic status based on rented houses only. In the models analysing days of care consumption, effects in owner-occupied houses were somewhat weaker. Effects in rented houses only (as well as the interaction terms socioeconomic deprivation by residential instability) were somewhat stronger.

The intra class correlations were low in all multilevel linear and logistic regression models. However, three of the five models showed statistically significant variation at neighbourhood level (σ^2_μ), indicating that neighbourhoods do matter. This supports the rationale for studying neighbourhood effects in all models. In addition, neighbourhood researchers tend to analyse neighbourhood effects, even when the intra class correlation and the neighbourhood variation are low, and it is generally held that this is warranted (35).

Finally, associations between socioeconomic deprivation and the social capital variables were so strong that collinearity problems would likely have arisen had these variables been entered jointly in one regression model. Therefore, unfortunately, the effects of neighbourhood socioeconomic deprivation and social capital cannot be disentangled. In order to avoid collinearity problems, future studies should stratify neighbourhoods by categories of socioeconomic deprivation and social capital and select the same number of neighbourhoods from each stratum.

Implications

Although we could not prove neighbourhood effects on the rate of treated mental health problems over and above individual differences, socioeconomic deprivation and social capital measures have been associated with various health perception measures in previous studies. If future longitudinal research can demonstrate that the relationships are causal, policy makers may be willing to put more effort in enhancing social capital within (poor) neighbourhoods. This could be achieved, for example, by facilitating and encouraging neighbours to engage in collective activities, in particular in working together to achieve higher neighbourhood goals in the area of health, safety and social wellbeing.

In addition, people usually evaluate the neighbourhood before buying or renting a house, so that theoretically individuals with similar preferences and characteristics will concentrate in particular neighbourhoods. In other words, similar types of persons tend to cluster in the same neighbourhood (social selection). This means that neighbourhood effects are not related to the geography of the neighbourhood itself but to the people actually living there. Thus, interventions should focus on the interaction between the neighbourhood on the one hand and the people living there on the other.

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4.2 Children's mental health service use, neighbourhood socioeconomic deprivation, and social capital

Background. There is accumulating evidence that the shared social environment at the neighbourhood level exerts significant effects on health over and above individual level variables. The aim of this study was to assess the interactive influence of neighbourhood measures of socioeconomic deprivation and social capital (i.e. informal social control, social cohesion and trust) on children's mental health service use, independent of individual-level confounders.
Methods. Two different data-sources were used:1) individual socioeconomic measures, derived from a case-control study in which case/control status indicated mental health service use or not, and 2) neighbourhood measures of socioeconomic deprivation and social capital. The data were subjected to multilevel logistic regression analysis.
Results. Children living in more deprived neighbourhoods run a higher risk of coming into contact with mental health care services. The social capital variables (informal social control and social cohesion and trust) did not exert main effects, but strong trust and social cohesion between citizens in the neighbourhood mitigated the risk-increasing effect of socioeconomic deprivation on children's mental health service use.
Conclusions. The deleterious effects of socioeconomic deprivation on mental health service use in children are sensitive to the context of cohesion and trust in neighbourhoods. Effects of deprivation on children's mental health cannot be interpreted without taking into account the context of social capital.

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Children's mental health service use, neighbourhood socioeconomic deprivation, and social capital

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Abstract *Background* There is accumulating evidence that the shared social environment at the neighbourhood level exerts significant effects on health over and above individual level variables. The aim of this study was to assess the interactive influence of neighbourhood measures of socioeconomic deprivation and social capital (i. e. informal social control, social cohesion and trust) on children's mental health service use, independent of individual level confounders. *Methods* Two different data sources were used: 1) individual socioeconomic measures, derived from a case-control study in which case/control status indicated mental health service use or not, and 2) neighbourhood measures of socioeconomic deprivation and social capital. The data were subjected to multilevel logistic regression analysis. *Results* Children living in more deprived neighbourhoods run a higher risk of coming into contact with mental health care services. The social capital variables (informal social control and social cohesion and trust) did not exert main effects, but strong trust and social cohesion between citizens in the neighbourhood mitigated the risk-increasing effect of socioeconomic deprivation on children's mental health service use. *Conclusions* The deleterious effects of socioeconomic deprivation on mental health service use in children are sensitive to the context of cohesion and trust in neighbourhoods. Effects of deprivation on children's mental health cannot be interpreted without taking into account the context of social capital.

Key words social capital – socioeconomic deprivation – children – mental health service use – pathways to care

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Introduction

Mental health service use in childhood has been linked to adverse socioeconomic circumstances at the individual level [1–5]. For example, results of a recent Dutch study showed that the probability of coming into contact with mental health care was significantly higher for children living in a one-parent household and children whose father was unemployed [3].

There is also accumulating evidence that the shared social environment at the neighbourhood level exerts significant effects on health over and above individual level variables. The shared social environment has been defined as those elements in the environment that people share with each other, such as physical and social aspects of the neighbourhood they live in [6–9]. Neighbourhood measures of "socioeconomic deprivation" and more recently "social capital" are components of this shared social environment.

Socioeconomic deprivation can be conceptualised as socioeconomic status (SES) at the neighbourhood level, and is usually composed of objective neighbourhood indicators, such as the proportion of unemployed, the proportion of people receiving welfare, ethnic composition and mean income. Previous research has reported asso-

ciations between socioeconomic deprivation and health. For example, a recent Dutch study, which controlled for individual SES, showed significant, albeit non-linear, associations between neighbourhood socioeconomic deprivation and problem behaviour among young children [6]. Child behaviour problems were more frequent in families of low parental occupation and education and, independent thereof, in families living in socioeconomically deprived neighbourhoods. This has also been reported in an American study in young children [10]. In addition, neighbourhood socioeconomic deprivation was associated with mental illness in children and adolescents [11].

More recently, social capital has also been identified as a neighbourhood factor that may be important for individual mental health. Social capital has been defined as "those features of social organisation – such as the extent of interpersonal trust between citizens, norms of reciprocity, and density of civic associations – that facilitate co-operation for mutual benefit" [8]. Social capital can be conceptualised as social integration measured as a collective characteristic [7]. Previous research reported a contextual effect of neighbourhood social capital on self-rated poor health, even after adjustment for individual level factors (e. g. low income, low education, smoking) [8]. Another study showed that one aspect of social capital, informal social control, was specifically associated with children's mental health and behaviour [9]. Therefore, characteristics of the shared social environment may also be associated with mental health service use (i. e. at risk for being diagnosed with mental illness).

Social capital and socioeconomic deprivation are correlated. Previous research has demonstrated that socioeconomic deprivation is associated with reduced levels of social capital. For example, a study showed that poverty, heterogeneity and mobility undermine neighbourhood networks and social ties, contributing to a breakdown in informal social control (ISC) [12]. A recent study [9] tried to unravel the effects of socioeconomic deprivation and social capital on child quality of life. However, because of the high correlations between neighbourhood socioeconomic deprivation and social capital, it was not possible to study their independent or interactive effects. Therefore, we hypothesised that socioeconomically deprived neighbourhoods might have an additional negative impact on mental health service use when these neighbourhoods were additionally low in social capital [13–15]. Thus, social capital might mitigate the effect of neighbourhood socioeconomic deprivation on children's mental health service use (the equivalent of showing an interaction between socioeconomic deprivation and social capital). Furthermore, a previous study hypothesised that the accumulation of socioeconomic problems in a deprived area might have an additional negative impact on mental health for people of low individual SES but not for people with high SES [16] (i. e. interaction between neighbourhood socioeconomic deprivation and individual socioeconomic status).

Until recently, most of the research on socioeconomic deprivation, social capital, and health focussed on the general population. Therefore, it is not yet known whether neighbourhood socioeconomic status and social capital are associated with more serious mental health problems, found in a clinical population. Goldberg and Huxley explained the help-seeking process in their "filter" model of mental health in adults [17]. Verhulst and Koot adapted this framework for child and adolescent mental health services [18]. The adapted model (Fig. 1) consists of five levels, each representing different circumscribed populations of children, including the community, primary care, and specialist psychiatric services populations. Between the levels there are four filters (including illness behaviour, recognition of the health problem, and referral behaviour of health professionals) representing the factors that determine which children go on to the next level. Child and family characteristics play a role along the entire referral pathway [18]. In this way, it can be understood that specialist psychiatric services populations are the ones that passed filters 3 or 4 and that these persons have much more serious mental health problems than persons identified by questionnaires in the general population [17, 19].

Given the fact that neighbourhood variables may exert their effects by impacting on the developmental stage in children [6, 20], the present study will investigate the influence of neighbourhood socioeconomic deprivation, and social capital in children who were clinical "cases" of mental health service use compared with a group of controls. In addition, the present paper addressed the interaction hypotheses by investigating: i) interaction effects between individual level SES and neighbourhood socioeconomic deprivation, and ii) interaction effects between neighbourhood socioeconomic deprivation and neighbourhood social capital.

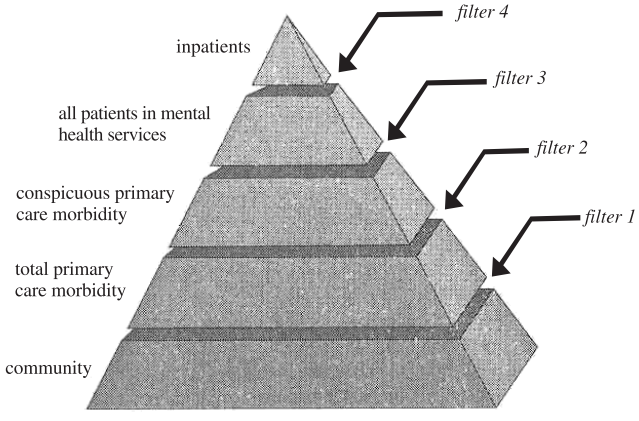

Fig. 1 Filter model psychiatric morbidity in children (Goldberg and Huxley [17] adapted by Verhulst and Koot [18])

Subjects and methods

Setting

Maastricht is a relatively small city (population 122,000) located in the south of the Netherlands. The population is of relative ethnic homogeneity, having relatively few non-Dutch inhabitants, in comparison with the ethnically more heterogeneous populations in the cities in the Northwest of the country [21]. Maastricht consists of 36 residential neighbourhoods and five non-residential neighbourhoods (e. g. industrial estates or nature conservation areas). The boundaries of these neighbourhoods follow main roads and are ecologically meaningful. Each of the 36 neighbourhoods houses between 300 and 8,500 inhabitants (all ages).

Since both general and mental health services in the Netherlands are accessible to everyone, the costs being covered by a compulsory national insurance scheme [22], financial or insurance considerations do not play a role in the help-seeking decision. In the Netherlands, recognition and referral behaviour of general practitioners and school physicians serve as an important filter to mental health service use. This also applies to Maastricht and surrounding areas, where the school physicians of the Youth Health Care Division from the Municipal Health Centre of Maastricht (YHCD) screen all school-going children. Children with suspected psychiatric morbidity are referred to a central intake team and from there referred to the Youth Department of the Community Mental Health Services. Previous research in the Netherlands has found that among the total population of children with mental health problems, those that are most severely affected come to the attention of psychiatric services [23].

Children with mental retardation are referred to specialised services outside mental health services and were, therefore, not included in the present study.

Furthermore, in Maastricht, the Maastricht Mental Health Case Register (MHCR) has since 1981 cumulatively collected data on the utilisation of mental health care in a catchment area of around 200,000 inhabitants (city of Maastricht: 120,000; surrounding areas: 80,000). All contacts with mental health care facilities by residents of the catchment area are registered cumulatively [24]. Thus, information is available on intakes, subsequent contacts, and discharges of patients in out-patient, day-patient and in-patient settings.

Research design

Two different data sources were used: 1) individual socioeconomic measures derived from a case-control study in which case/control status indicated mental health service use or not, and 2) neighbourhood measures of socioeconomic deprivation and social capital.

Cases and controls, mental health service use

Parents of 120 consecutive referrals aged 6–13 years to the child psychiatric department of the community mental health centre (hereafter: cases) were asked for informed consent, yielding 80 cases (66%). These cases were the mental health service users. For each case, four controls (not using mental health services) were selected of the same gender and year of birth. The total sample thus comprised 400 children (80 cases and 320 controls) living in Maastricht and surrounding areas. For these 400 children, living in Maastricht and surrounding areas, data were obtained from routine examinations at the YHCD, where all children from foetal life to the age of 19 years are periodically screened. The parents of the 80 cases that were included in the case-control study provided consent to examine these data and to obtain the clinical diagnosis recorded in the Community Mental Health Service files. A comparison sample of controls was selected from the YHCD files by a YHCD staff-member, who simultaneously handed over the files of cases and controls to the researchers, who, thus, remained blind to case-control status [3]. The parents of the controls were not asked for individual permission, as it is within the legal remit of the YHCD to conduct anonymous group comparisons within collected data. Since the YHCD archives also contain addresses of the children, the neighbourhood of the children was included in the dataset. For the present study, the children living in the neighbourhoods of the city of Maastricht were selected yielding a final sample of 262 children (56 cases and 206 controls). Data obtained from the Maastricht Mental Health Case Register were used to describe so-called 'episodes of care' of the 56 cases. An 'episode of care' can be simply defined as the time interval between a first service contact for a mental health problem and a 'last' contact with the services. The most useful definition of last contact in the field of mental health care which has been tested using case register data is 'a contact, after which there is a gap of 90 days or more without any further contact' [25]. This last contact has been applied to the end of a single episode of care.

Neighbourhood socioeconomic measures

The city of Maastricht statistics department and the National Statistics Institute (CBS) supplied the objective data of the neighbourhoods of Maastricht. The following variables were obtained: percentage single-parent families, two-parent families, single persons, departure, settlement, mobility within neighbourhoods, total mobility, mobility balance, ethnicity (defined as non-Dutch nationality), non-voters, school absenteeism, unemployment benefit, unemployment benefit more than 1 year, unemployment benefit more than 3 years, social welfare benefit, social welfare benefit more than 3 years, mean income, mean income for persons employed 52 weeks per year, proportion high incomes, proportion low incomes, and proportion economically inactive. In order to summarise these data into a lesser number of underlying constructs, a factor analysis (principal factors without rotation) was carried out. The two identified factors, hereafter called "socioeconomic deprivation" and "residential instability", explained 70% of the total variance. Percentage single-parent families, ethnicity, non-voters, unemployment, unemployment more than 1 year, social security, social security more than 3 years, mean income, mean income for persons employed 52 weeks per year, percentage high and low incomes and percentage economically inactive loaded on deprivation. Single persons and all mobility variables loaded on residential instability. Regression factor scores were calculated for the socioeconomic deprivation construct, yielding continuous variables with mean 0 and unity standard deviation. Socioeconomic deprivation had a normal distribution and higher scores indicated more socioeconomic deprivation (Table 1) [9]. Residential instability was not included in the current analyses.

Social capital

Objective neighbourhood measures of socioeconomic deprivation as well as subjective neighbourhood measures of social capital were used. Social capital was measured in a Maastricht community survey, using two collective efficacy scales: informal social control (hereafter: ISC) and social cohesion and trust (hereafter: SC&T), developed by Sampson and colleagues [7], and adapted to the Dutch situation [9]. The ISC scale measures the willingness to intervene in hypothetical neighbourhood-threatening situations; for example, in the case of children misbehaving or the opening of a brothel in the street. This scale is conceived in such a way that respondents are independent informants about their neighbours' willingness to intervene. The SC&T scale measures bonds and trust among the residents of the neighbourhood. Both scales were translated into Dutch and back-translated into English. For the community survey, approximately 200 inhabitants aged 20–65 years were randomly selected from each of the 36 Maastricht neighbourhoods, using the municipal database. These inhabitants received a questionnaire on social capital, which they were asked to send back [9]. The response rate was 48% and the answers of the respondents were aggregated to the neighbourhood level. This resulted in continuous neighbourhood ISC and SC&T variables, which were standardised (SD = 1) for the present study. Higher scores on the social capital variables indicated lower levels of ISC and SC&T (Table 1).

Table 1 Interpretation of the neighbourhood socioeconomic and social capital scores

Deprivation	High score: deprived neighbourhood Low score: advantaged neighbourhood
Informal social control (ISC)	High score: low informal social control in the neighbourhood Low score: high informal social control in the neighbourhood
Social cohesion and trust (SC&T)	High score: no trust between people in the neighbourhood Low score: strong trust between people in the neighbourhood

Table 2 Means, standard deviations, and Pearson correlation coefficients of neighbourhood socioeconomic and social capital variables

		Descriptives			Pearson correlations	
	Neighbourhood N	mean	Sd	Range	ISC	SC&T
Socioeconomic Deprivation	35	0.00	1.00	−1.69–1.68	0.65*	0.89*
ISC	36	29.10	1.00	24.54–32.79	1.00	0.68*
SC&T	36	22.25	1.00	16.71–28.00	0.68*	1.00

* $p < 0.001$

Correlations between socioeconomic deprivation and social capital variables

Neighbourhood socioeconomic deprivation was not concentrated in the centre of Maastricht and, although there were some notable exceptions, deprived neighbourhoods and neighbourhoods with little SC&T tended to cluster together although there was no perfect overlap (Fig. 2). The Pearson correlations between socioeconomic status and ISC and SC&T, presented in Table 2, are respectively 0.65 to 0.89 and are statistically significant.

Individual socioeconomic status, year of birth, and gender

For the 262 cases and controls, occupational status, work situation, and marital status of the children's parents, selected from the YHCD files, were used as indicators of individual level socioeconomic status, the individual level equivalent of neighbourhood socioeconomic deprivation. Occupational status was a categorical variable, with four categories: low (e. g. manual employees), middle (e. g. clerical employees, owners of small businesses, technicians, minor professionals), high (e. g. supervisory employees, major professionals, owners of large businesses, executives, teachers), and university level (e. g. lawyer, doctor). The category 'middle' was the reference category. Work situation, also a categorical variable, had two categories: employed and unemployed. Marital status consisted of the categories: partner and single. The three categorical variables had between 5 and 18 % missing values. Therefore, missing values were entered in the model as an extra category, so that subjects having a missing value were not excluded from the analyses. All three categorical variables were recoded into dummy variables.

Year of birth and gender were also included in the analyses, because the controls in the case-control study [3] were matched for year of birth and gender. Year of birth was recoded into the age of the child in the year 2002. Age was treated as a continuous variable, 'male' was the reference category for sex.

Statistical analyses

Data were part of a multilevel structure with level-one units (individuals) clustered into level-two units (neighbourhoods). Multilevel modelling techniques are a variant of the more often used unilevel analyses and are ideally suited for the analysis of clustered data, in this

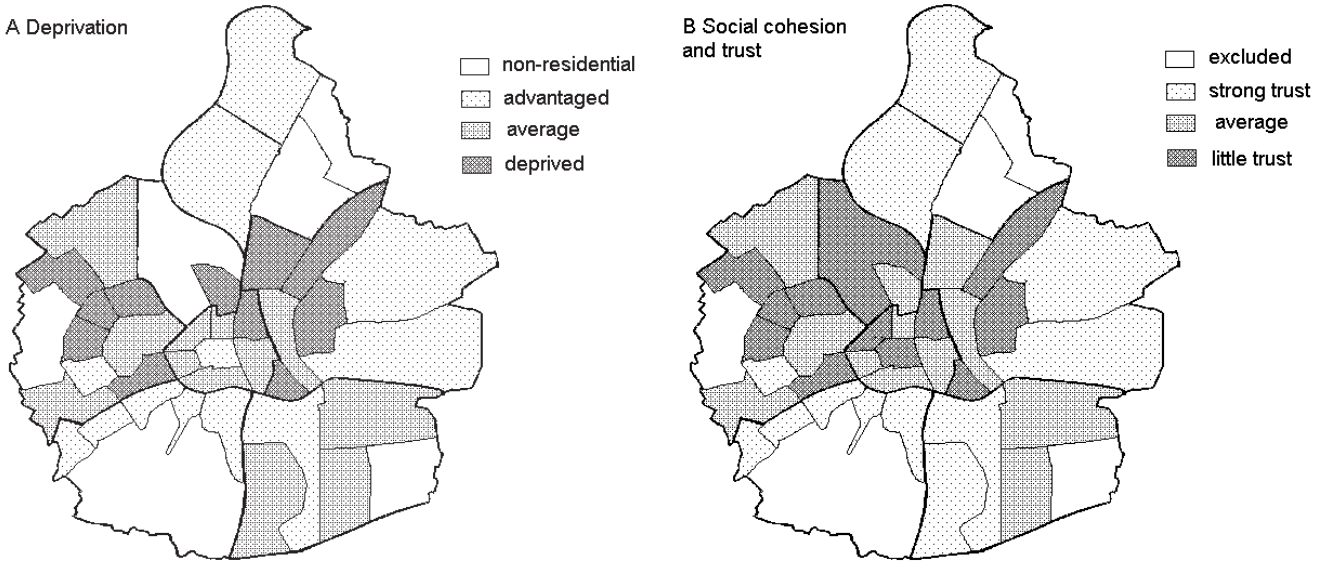

Fig. 2 Neighbourhood variation in socioeconomic deprivation and social cohesion and trust.

case consisting of multiple persons clustered within a single neighbourhood. Therefore, the data were subjected to multilevel logistic regression analysis [26] (using generalised estimation equations) in order to investigate neighbourhood effects while controlling for individual effects. The odds ratios (ORs), the regression outcomes of the predictors in this type of analyses, can be interpreted identically to the estimates in ordinary unilevel logistic regression.

All analyses were performed using STATA [27]. The analyses testing the influence of neighbourhood level variables on children's mental health service use (dependent variable) were controlled for individual level SES (i. e. work situation, occupational status, and marital status), age, and gender.

All models were tested for deviation from linearity by adding squared exposure terms to the models, and since none of the tests showed statistically significant deviation from linearity, socioeconomic deprivation and social capital were entered as linear continuous variables throughout. Furthermore, an interaction between neighbourhood socioeconomic deprivation and individual level SES variables was examined.

In addition, neighbourhood socioeconomic deprivation and the social capital variables were entered jointly in the model (β_1 deprivation$_j$ + β_2 ISC$_j$ + β_3 SC&T$_j$ + individual variables) in order to assess to what degree any effects of these neighbourhood variables were mutually independent. Furthermore, an interaction term between socioeconomic deprivation and ISC and an interaction term between socioeconomic deprivation and SC&T were included in order to examine interaction effects between socioeconomic deprivation and social capital.

Results

Sample

The sample of the present study consisted of a total of 262 children, 206 controls and 56 cases, living in Maastricht and for which neighbourhood data were, therefore, available. In the group of 262 children, 67 % were male (Table 3).

About 50 % of the 56 mental health care users had three or more episodes of care. An episode of care was characterised by a mean number of eight contacts and a mean duration of 127 days (not in the table).

The mean age of the children, in the year 2002, was 10.4 years, with a standard deviation of 2.5. Of the parents, 44 % had required middle-level education for their profession, 15 % had required low-level or high-level education for their profession, and 10 % had required an academic degree. In all, 211 children (80.5 %) had a working mother or father, and 10 % of the children lived in single-parent families (Table 3).

Associations between socioeconomic deprivation, social capital, and mental health service use

The models including one neighbourhood exposure variable at a time, both crude and controlled for individual level confounders, indicated that socioeconomic deprivation was significantly associated with mental health service use. There was no statistically significant association between ISC and SC&T on the one hand, and mental health service use on the other (Table 4).

When neighbourhood socioeconomic deprivation and social capital were entered jointly in the model and interaction was tested, a positive interaction between socioeconomic deprivation and one aspect of social capital, the degree of SC&T (OR = 1.39, p = 0.04), was found (Table 4). There was no significant interaction between socioeconomic deprivation and ISC (OR = 1.18, p = 0.35; data not shown). To further illustrate the dynamics of the interaction, we stratified the data by quartiles of SC&T (Table 5).The ORs of deprivation in four different strata of SC&T show that the effect of socioeconomic deprivation on mental health service use was stronger in neighbourhoods with little SC&T between citizens (thus, a higher SC&T score). Because of smaller numbers

Table 3 Description of individual level confounders

	Cases		Controls	
	Frequency	Percentage	Frequency	Percentage
Occupation status				
Middle	26	46.4	88	42.7
Low	10	17.9	28	13.6
High	6	10.7	33	16.0
Science	4	7.1	21	10.2
Missing	10	17.7	36	17.5
Work situation				
Employed	41	73.2	170	82.5
Unemployed	9	16.1	18	8.7
Missing	6	10.7	18	8.7
Marital status				
Partner	40	71.4	182	88.4
Single	11	19.6	14	6.8
Missing	5	8.9	10	4.9
Gender				
Male	39	69.6	133	64.6
Female	17	30.4	73	35.4
Total	56	100	206	100

Table 4 Associations between neighbourhood level socioeconomic measures and social capital on the one hand and mental health service use on the other

Model without interaction term	Mental health service use OR (95 % CI)
Neighbourhood socioeconomic measures	
Socioeconomic deprivation crude	1.41 (1.07, 1.84)*
Socioeconomic deprivation**	1.36 (1.00, 1.84)*
Social capital	
Informal social control (ISC) crude	1.28 (0.95, 1.72)
Informal social control (ISC)**	1.21 (0.89, 1.64)
Social cohesion and trust (SC&T) crude	1.30 (0.99, 1.70)
Social cohesion and trust (SC&T)**	1.24 (0.92, 1.67)
Model with interaction term	**Mental health service use OR (95 % CI)**
Socioeconomic deprivation	2.52 (1.06, 6.03)*
Informal social control (ISC)	1.23 (0.89, 1.71)
Social cohesion and trust (SC&T)	0.40 (0.16, 1.02)
Deprivation x SC&T	1.39 (1.02, 1.92)*

* $p < 0.05$

** corrected for individual SES (occupational status, work situation, and marital status), children's gender and age in 2002

Table 5 Effects of socioeconomic deprivation on mental health service use, stratified by Social Cohesion and Trust (SC&T)

	Stratum SC&T 1 (Strong trust)* OR (95 % CI)	Stratum SC&T 2 (Trust) OR (95 % CI)	Stratum SC&T 3 (Little trust) OR (95 % CI)	Stratum SC&T 4 (No trust) OR (95 % CI)
Deprivation	0.58 (0.04, 9.05)	2.15 (0.85, 5.45)	2.77 (0.51, 14.9)	2.06 (0.77, 5.52)

* low score on SC&T variable

in the strata, the ORs were not statistically significant – the interaction, however, is a test of whether the ORs in the different strata are significantly different from each other.

Associations between individual level variables and mental health care use

Single marital status was associated with mental health service use (OR = 3.28, p = 0.019). No significant association between the other individual level socioeconomic variables and mental health service use was found. Furthermore, there was no evidence for an interaction effect between individual level socioeconomic status and neighbourhood level socioeconomic deprivation.

Discussion

Associations between neighbourhood socioeconomic measures, social capital, and mental health service use

Children living in socioeconomically deprived neighbourhoods were more likely to come into contact with mental health care services. Furthermore, the effect of neighbourhood socioeconomic deprivation on mental health service use was stronger in neighbourhoods with lower levels of SC&T between citizens. Thus, neighbourhood socioeconomic deprivation cannot in itself explain the higher mental health service use and has to be interpreted in the context of neighbourhood social cohesion.

The association between neighbourhood socioeconomic deprivation and mental health is in line with previous research in children and adolescents. Multilevel studies have reported associations between both individual socioeconomic status and neighbourhood socioeconomic deprivation on the one hand and life stress in adolescents [28], problem behaviour in children and adolescents [6, 10], and mental illnesses in children [11] on the other hand. In addition, socioeconomic deprivation has been associated with mental health service use in adults [29]. Only some studies reported that socioeconomic deprivation effects on mortality and mental health in adults, respectively, were mostly attributable to individual level SES [16, 30].

Low social capital has been reported to be associated with poor perceived health in adults [8] and low levels of social cohesion have been found to be specifically associated with depression in adolescents, and tentatively with anxiety and defiant behaviour [31]. In addition, social cohesion and trust has been associated with children's quality of life in general, and informal social control with children's mental health and behaviour specifically [9]. However, the present study did not find a statistically significant association between social capital and mental health service use. A possible explanation for this may be that previous research focussed on general populations rather than on a clinical population as in the current study. It may be that clinical populations, with a concentration of the most severe mental health problems, are less sensitive to the effects of social capital than lower levels of mental health problems that are distributed across the general population.

Even so, to our knowledge, the present study is the first to report an interaction effect between socioeconomic deprivation and one aspect of social capital, SC&T. What previous research did demonstrate was that socioeconomic deprivation is associated with reduced levels of SC&T [13–15]. For example, a study showed that poverty, heterogeneity, and mobility undermine neighbourhood networks and social ties, contributing to a breakdown in ISC [12]. Furthermore, Wacquant and Wilson [32] found that residents in poor neighbourhoods were less likely to report the presence of regular sources of social support, including a marital partner and close friends. However, there is not always a perfect relationship between socioeconomic deprivation and SC&T [9], and Fig. 2 shows that some deprived neighbourhoods do not have little trust and some advantaged neighbourhoods do not have strong trust.

Social cohesion enhances well-being [14]. For example, it is known that groups with strong social bonds between their members will tend to react to the mentally ill with attempts to maintain them within the group [33]. In contrast, people living in neighbourhoods with little social cohesion will be more likely to exclude the individual from the group and mentally ill persons seek help from professionals more quickly. This can be an explanation for our finding that strong social cohesion decreased the adverse effect of neighbourhood socioeconomic deprivation on children's mental health service use.

Associations between mental health care use and individual level variables

Of the individual level variables, only parental single marital status was associated with mental health service

use. Therefore, the present results suggest that the effect of neighbourhood socioeconomic status on children's mental health service use is of more importance than individual level socioeconomic status variables. However, although occupational status is one of the best measures of individual level SES in the Netherlands [34], the possibility remains that residual confounding may have led to spurious results at the neighbourhood level because of omitted variable biases [35].

Other methodological issues

A possible methodological issue is that mental health care use does not only depend on severity of symptoms, but is also a result of referrals. Therefore, it could be that the differences between neighbourhoods are the result of differences in referral patterns rather than differences in mental health. However, previous research showed that children who attend psychiatric services in the Netherlands are those with the highest level of psychiatric morbidity and need for care [23]. Furthermore, we think it unlikely that mentally ill children living in poor neighbourhoods are more readily referred to psychiatric services than children living in affluent neighbourhoods, as only this bias would result in spurious results. Therefore, in the present study, differences in mental health service use can be assumed to reflect real differences in mental health. On the other hand, because children who attend psychiatric services can be considered as those with the highest level of psychiatric morbidity and need for care, [23] the results of the present study may not necessarily be valid for all mental disorders, in particular the less severe disorder, or poor mental health below the threshold of disorder. A person has to pass different filters before coming into contact with mental health services. Mental health service users are the ones that passed the last filters.

Working with routine data such as the Maastricht YHCD files introduces a fairly large degree of misclassification, especially in the case of not-systematically assessed variables such as open comments, where the risk of false negatives is highest. However, the individual SES variables (occupational status, work situation, and marital status), age, and gender used in the present study did not consist of such open comments and were recorded routinely and systematically. Therefore, it is not likely that any degree of misclassification would have influenced the present results in an important way.

Results showed high correlations between the three neighbourhood variables, especially between socioeconomic deprivation and SC&T (Pearson correlation of 0.89). Therefore, the possibility exists that when all neighbourhood variables are included in one model, the effects of these variables on children's mental health service use would disappear as a result of collinearity. Nevertheless, when the neighbourhood variables were combined in one model, significant results were present.

The response rate in the community survey, measuring social capital, was only 48 % and the response rate in neighbourhoods with higher deprivation scores was even lower [9]. However, the community sample respondents and the general population between 20 and 65 years of age had similar distributions in age, gender, and ethnicity. Furthermore, all respondents were considered to be "key" informants about their own neighbourhood, with the implicit assumption that responders gave the same information about the neighbourhood as the non-responders would have given. The validity of the sample might have been judged differently if the principal objective had been to obtain information on the person, not his or her neighbourhood. Thus, this information is more or less independent of the response rate, even if it were as low as it was in the neighbourhood with the lowest response. In order to verify this assumption, we examined *post hoc* associations between ISC and SC&T collected in the community survey and those collected in another Maastricht data collection with a response rate of 60 % (reproducibility). Neighbourhood scores on ISC and SC&T based on these questionnaires were highly correlated.

The present study conducted unmatched analyses of data from a matched case-control study. Traditionally, an unmatched analysis of matched data is more likely to yield type II errors. However, given the broad matching on sex and year of birth, both non-crucial exposures in the study, it is unlikely to have reduced statistical power to a great degree.

In general, most individuals perceive their neighbourhood as comprising their own street and perhaps one or two side streets (perceived neighbourhoods). The neighbourhoods defined in the present study were much larger. Clustering these neighbourhoods means that information about the shared environments of the perceived neighbourhoods is lost. However, empty multilevel models with the individual answers on the ISC and the SC&T scales revealed not only variance at the individual level, but also at the neighbourhood level, indicating that the answers were grouped within the neighbourhoods or, in other words, that neighbourhoods differ from each other [9].

Implications for intervention

Early intervention is a pressing issue given the increasing number of referrals to child psychiatric services [36]. Up till now, the possibilities for early intervention included early parenting and family support strategies. For example, support and aid to parenting may be crucial for mentally ill parents to prevent relapse and promote the child's mental health [37].

However, the fact that socioeconomically deprived neighbourhoods with low levels of SC&T have an additional risk would imply that prevention programmes for high-risk children should also focus on neighbourhood characteristics, in addition to the interventions already provided. For example, building more facilities that al-

low children to play together and parents to meet each other may enhance the social cohesion of the neighbourhood and can, in that way, decrease the effect of neighbourhood socioeconomic deprivation. However, as far as we know, our study is the first to find an interaction effect between socioeconomic deprivation and SC&T and this result is in need of independent replication. In addition, although theoretically case-control studies are longitudinal studies [38], in the present study the neighbourhood exposure variables were collected after identifying the cases and the controls. Therefore, causality cannot be inferred.

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Chapter 5

Discussion

5.1 Discussion

The present thesis describes associations between neighbourhood social capital and other neighbourhood measures, such as socioeconomic deprivation, on the one hand and quality of life and treated psychiatric morbidity on the other. Below, the articles presented in the previous chapters are summarised and discussed. In addition, some further methodological issues are addressed.

Mediating effects of social capital

The articles included in chapter 2 all place the concept of social capital in a wider perspective. First, individual perceptions of social capital were studied. Furthermore, social capital was believed to play a role in the mechanisms of the effects of neighbourhood residential instability and income inequality.

Analyses of neighbourhood perceptions were described in section 2.1. Using data of a community survey, this section showed that neighbourhood socioeconomic deprivation was associated with lower levels of perceived health and mental health, and albeit statistically inconclusive by conventional alpha, with lower levels of vitality (adjusted analyses). In addition, the influence of three sets of individual-level mediators on the association was assessed (1 lifestyle, 2 housing characteristics, and 3 perception of housing and the neighbourhood social and physical environment).

When including the set of neighbourhood perception variables in the models, associations between socioeconomic deprivation and all outcome variables disappeared. In addition, the two perception variables with the strongest mediating effects (when included one at a time) were perceptions of neighbourhood cosiness[1] and neighbourhood social contacts. Certain conditions, such as neighbourhood maintenance and quality of housing, will per definition be worse and be perceived as worse in poor neighbourhoods than in affluent neighbourhoods, but not cosiness and social contacts. These are measures of social interaction rather than measures of poverty and, therefore, represent an entirely different construct.

Although measured at the individual level, both cosiness and social contacts are strongly related to the concept of neighbourhood social capital. Because even these individual-level perceptions seemed to play an important role, studying neighbourhood-level social capital was a logical next step. As stated in the introduction, perceptions of social capital are always biased by individual quality of life status. This makes it difficult to disentangle cause and effect when measuring social capital and quality of life in the same group of respondents. If social capital measures are collected in a sample of informants independently of the study, sample contamination by individual perceptions of the study population can be avoided (Buka et al., 2003). All research described below included social capital measures and other neighbourhood measures that were collected separately. Thus, individual perceptions of the group of respondents were not studied, but also rather more distal mechanisms.

Residential instability

Although residential instability was not associated with our measures of social capital (see section 3.1), theoretically these two concepts are very much linked (Sampson, 1997).

[1] There is no English equivalent of the Dutch word "*gezelligheid*" that is used in the questionnaire. We chose the word "*cosiness*", but *"gezelligheid"* is also a combination of closeness, warmth and friendliness.

Maintenance of social capital is difficult when the neighbours keep on moving. Residents are then forced to exert much effort in remaking social contacts with new neighbours. So, theoretically social capital plays a role in the mechanism of effects of residential instability, in the sense that residential instability would lead to lower levels of social capital and therewith to lower levels of quality of life. Section 2.2 described analyses of the community survey data on residential instability.

A previous study on residential instability conducted in the United States showed interaction effects; the association between socioeconomic deprivation and well being was greater in stable neighbourhoods (Ross et al., 2000). Analyses described in section 2.2 were done to replicate these findings and the results suggested that indeed the effects of socioeconomic deprivation were most salient in neighbourhoods with low residential turnover. Thus, residential **in**stability may be beneficial in deprived neighbourhoods. The social isolation perspective invoked by Ross and colleagues (Ross et al., 2000) seems to work in Maastricht as well. According to this perspective, neighbourhood socioeconomic deprivation in poor stable neighbourhoods may be more distressing. Stability in poor neighbourhoods is perceived by residents as tantamount to being trapped and powerless in a dangerous and frightening place. Most likely, promoting frequent moving of residents living in poor neighbourhoods is no solution for the problem. Probably helping residents in (stable) poor neighbourhoods to find job opportunities could help them to overcome the feeling of being trapped in a desperate and hopeless situation.

Because of the theoretical link with social capital, living in a stable neighbourhood was expected to be beneficial both in poor and affluent neighbourhoods. If social capital was mediating the effects of residential instability, higher levels of quality of life would have been found in stable neighbourhoods. No such effect was apparent and, on the contrary, residential stability seemed to be a disadvantage in poor neighbourhoods. However, this same interaction effect also indicates that residents of affluent neighbourhoods only benefit from living in an affluent neighbourhood if this neighbourhood is stable. Theoretically, this effect could be argued to be the consequence of higher levels of social capital in stable affluent neighbourhoods. However, since the measures of social capital used in the MQoL were not associated with residential instability, the role of social capital as a mechanism in the dynamics of residential instability remains doubtful even in affluent neighbourhoods.

Income inequality

Social capital has been described as one of the mechanisms that explain why higher levels of income inequality are associated with lower levels of health (Kawachi et al., 1999b). For this reason income inequality has been addressed in section 2.3, using data of the parents of the family cohort study. It has been argued that it may not be the absolute levels of objective socioeconomic deprivation, as described in section 2.1 and 2.2, that contribute to health problems (the absolute income hypothesis), but rather that the causal factor is income inequality within a geographical unit, suggesting that everyone, poor or rich, would benefit from a more equal income distribution (the relative income hypothesis) (Kawachi et al., 1999b). However, the analyses presented in section 2.3 showed that neighbourhood-level measures of income inequality were not associated with any of the quality-of-life outcomes. Our findings were in agreement with other studies using smaller areas, which also did not find evidence for effects of income inequality. On the other hand, most studies on income inequality and mortality at state- or country-level did report associations between income inequality and outcomes. Results of a study on

perceived health studying income inequality at different levels of aggregation also showed associations with income inequality at county level but not at census-tract level (Soobader and LeClere, 1999). Therefore, guided by the work of Wilkinson (Wilkinson, 1997), one could formulate a more specific relative income hypothesis, applicable to geographical areas with large population sizes only (i.e. large counties or larger). Although most research studied mortality measures, this more specific hypothesis seems also valid for quality of life (section 2.3) and perceived health (Soobader and LeClere, 1999).

One of the pathways that have been proposed to underlie the relative income hypothesis is that inhabitants living in areas with higher levels of income inequality may belong to different social groups, creating social divisions that may be difficult to overcome. The resulting lower levels of social capital (e.g. social bonds) have been reported to be associated with poor health (Kawachi et al., 1999b). However, the proposed mechanism seemed to specifically involve neighbourhood-level social capital, while income inequality only plays a role at larger levels of aggregation. Thus, neighbourhood-level social capital is not on the pathway between income inequality and health outcomes.

Associations between neighbourhood factors

The analyses described in chapter 3 and 4 all included neighbourhood-level social capital. Before answering whether these social capital variables were associated with quality of life and mental health outcomes, associations between the social capital variables and the other neighbourhood variables, socioeconomic deprivation and residential instability were studied (section 3.1). More socioeconomically deprived neighbourhoods were reported to have lower levels of informal social control and lower levels of social cohesion and trust. Unfortunately, associations were so strong that collinearity problems could arise, when analysing socioeconomic deprivation and social capital in the same regression model. Therefore, results of the cohort study were based on models entering the neighbourhood variables separately. Only when studying interaction effects between two neighbourhood variables, both variables and the interaction term were entered jointly.

Although the MQoL showed that lower levels of socioeconomic deprivation were associated with higher levels of social capital, previous research has reported that contrarily close ties and mutual aid are predominant features of poor areas, enabling people to cope with poverty (McCulloch, 2003, Bruhn and Wolf, 1979). In addition, Maastricht social workers noticed much more social interactions in poor than in affluent neighbourhoods. However, the results showed that despite these interactions, residents of Maastricht poor neighbourhoods had a lesser degree of trust in their neighbours. It is possible that residents of affluent neighbourhoods are more sensitive and therefore more easily annoyed with deviant behaviour of neighbour children, which leads to higher levels of informal social control. This interpretation is supported by the Chicago research that reported neighbourhoods with concentrated disadvantages to be associated with sharply lower expectations for shared child control (Sampson et al., 1999). In addition, these residents may know that they can count on their neighbours when necessary. This may lead to perception of higher levels of social cohesion and trust.

The strong associations between the neighbourhood factors support the social disorganisation theory, which poses that socioeconomic deprivation and lower levels of social capital are linked (Markowitz et al., 2001, Kawachi et al., 1999a). However, only two dimensions of social capital were studied; other dimensions of social capital, not included in the present thesis, may not be associated with socioeconomic deprivation so strongly.

Adolescents' health-related quality of life

Furthermore, section 3.1 reported on associations between neighbourhood variables and adolescents' quality of life. The children of the family cohort study (aged approximately 11) received a questionnaire including all questions of the CHQ (Landgraf et al., 1996, Wulffraat et al., 2001, Raat et al., 2002). The CHQ is a generic health instrument that measures the behaviour and physical, emotional, and social well-being of children and adolescents. Results showed that both socioeconomic deprivation and measures of social capital were associated with quality of life. In addition one aspect of social capital, informal social control, was specifically associated with adolescents' mental health and behaviour. This effect is to a large degree independent of adolescents' general health. This specific result could be explained by the compliance with norms and values. If adolescents experience more social control they may better know which norms and values they are expected to follow, and what happens if they don't. This structure in daily life may directly impact on the behaviour and indirectly on feelings of mental health. This interpretation finds support in the general strain theory (Agnew et al., 2002, Aseltine et al., 2000). This theory emphasizes the role of adolescents' affective responses to negative life experiences in causing deviant behaviour. The theory contends that adolescent negative emotionality, when coupled with low social control, will be more likely to react with delinquency to the strains of normal developmental change.

Social capital in different cultural settings

Since the informal-social-control and social-cohesion-and-trust scales were adapted from the PHDCN (Project on Human Development in Chicago Neighborhoods, see chapter 1) (Sampson et al., 1997), these measures could be compared between the Chicago and the Maastricht study sites (section 3.2). Results indicated that Maastricht had lower levels of informal social control, while Chicago had lower levels of social cohesion and trust. In addition, informal social control showed more variation in Chicago neighbourhoods, which suggests sharper contrasts between neighbourhoods. These differences may reflect true differences in community functioning in Maastricht and Chicago or may reflect differences in the way respondents understood and answered the questions in each study.

In addition, higher levels of socioeconomic deprivation and lower levels of social capital were associated with lower perceived health of the early adolescents (one question was: "How do you perceive your health?"; answers between 1 "excellent" and 5 "poor") in the Maastricht sample and in the Chicago Hispanic sub sample. However, these associations were not found in the Chicago non-Hispanic sample.

Thus, associations between social capital and perceived health seem to have different magnitudes in different populations. More research is needed to investigate in what populations social capital plays an important role, and why social capital is not associated with health outcomes in other populations.

Child's growth and school achievement

In order to be able to discuss a broad range of outcomes important in social capital research, results of analyses of an objective measure of general health, growth, and results of analyses of school achievement have been reported in section 3.3 and 3.4, respectively.

Although social capital has been reported to be associated with mental health in the present thesis as well as in previous studies (McKenzie et al., 2002), there was no

evidence of an association between children's growth and social capital. Thus, neighbourhood measures may play a role, but effects seem to be more readily expressed in the psychological rather than the physical domain, in children living in the Netherlands.

In addition, analyses of school achievement (section 3.4) showed that school achievement was lower in socioeconomically deprived neighbourhoods and in neighbourhoods with lower levels of social capital (i.e. informal social control and social cohesion&trust) before controlling for confounders. However, after controlling for individual-level demographic and socioeconomic factors, most associations disappeared. Neighbourhood or individual poverty may affect school performance when adolescents living in poor neighbourhoods are more often absent from school because of their ill health and higher sickness rates (McLoyd, 1998). Because neither the objective measure of physical health, nor school achievement were associated with neighbourhood socioeconomic deprivation, there is no evidence that lower levels of health in poor neighbourhoods affect school achievement in these neighbourhoods. However, one aspect of the neighbourhood environment, informal social control, was associated with school achievement in boys only. Thus, not only mental health and behaviour (section 3.1), but also school achievement in boys were specifically associated with informal social control.

Follow-up: changes in self-reported quality of life and behaviour

Between two and three years after the baseline measurement, adolescents of the family cohort received a second questionnaire, that included relatively the same questions as at baseline. Section 3.5 discusses results of analyses of quality of life at follow-up controlling for baseline values. This way, associations between neighbourhood variables and changes in quality of life were addressed. The results did not show an association between neighbourhood variables and general health and mental health, neither before nor after controlling for baseline values. Thus, while quality of life of 11-year olds was associated with neighbourhood context, quality of life of 13/14 year olds was not.

However, associations between neighbourhood socioeconomic deprivation and self-esteem, satisfaction, and behaviour were reported in subgroups. Adolescents had higher levels of self-esteem and satisfaction when family socioeconomic status and neighbourhood socioeconomic deprivation concurred. The increasing self-esteem of adolescents from lower educated families in poor neighbourhoods may indicate that they were more likely to associate with specific peer groups of adolescents with similar family backgrounds. A similar mechanism may apply to adolescents from higher educated families living in affluent neighbourhoods. Under specific conditions of persistent poverty and lower levels of parental education, individuals may be more likely to join a specific form of youth peer group (generally termed as gang) that has compensatory functions for deficits in the neighbourhood and at home (Spergel, 1992, Valdez, 2003, Hill et al., 1999). Thus, results suggested that psychological outcome and socioeconomic conditions for gang formation do exist in Maastricht, although these 'gangs' do not perform large-scale illegal activities.

Strong social cohesion and trust mitigated the associations between socioeconomic deprivation and self-esteem in adolescents with non-concurring family socioeconomic status and neighbourhood socioeconomic deprivation. Thus, not only neighbourhood socioeconomic deprivation, but also social capital is still an important factor in subgroups of 13/14 year olds.

In addition, the follow-up data showed that socioeconomic deprivation was associated with the development of behavioural problems in the subgroup of children of higher

educated parents living in residential unstable neighbourhoods. Thus, changes from baseline behavioural status occasioned by the wider social environment in the time window from late childhood to early adolescence were only evident in selected subgroups of adolescents (not presented in the present thesis).

If models including baseline values of the outcome measures showed an association between social capital and outcomes, this would be strong evidence for causal effects of social capital. However, not finding these associations does not rule out causality. The two to three years between baseline and follow-up may be too short to measure an effect or effects of social capital that may be induced at earlier or later stages of development. Moreover, the interaction effect between social cohesion and trust and socioeconomic deprivation in the association with self-esteem, does indicate the importance of social capital in 13/14 year olds.

Service consumption in adults

Population measures of quality of life and mental health may yield different results than more objective measures of mental health service use, that can be termed "treated psychiatric morbidity". Therefore, a data set was constructed including all incident cases registered in the Maastricht Mental Health Case Register (in the year 2000, all diagnoses, persons aged between 20 and 65 years) and population controls. Community Survey respondents functioned as the population control group. Multilevel logistic regression using this case-control data set enabled us to study service use rates controlled for individual-level demographic variables and socioeconomic status. Results have been described in chapter 4 (section 4.1).

Crude analyses showed that all neighbourhood factors were associated with service use rates. In neighbourhoods that are worse off (socioeconomically deprived or low levels of social capital) rates were about 10 to 20 per cent higher. However, after controlling for individual-level demographic (and socioeconomic) factors, none of the neighbourhood factors were associated with service use. Thus, subjective measures of mental health are most responsive to neighbourhood factors, while neither effects of neighbourhood socioeconomic deprivation nor effects of social capital are large enough to actually prove these effects studying the objective measures of adult's treated psychiatric morbidity.

Children's mental health service use

Treated psychiatric morbidity was also studied in children (section 4.2), using data of a case-control study (Gunther et al., 2003). Although there were no effects of social capital on adult service use (section 4.1), there were associations in children. The case-control data showed that children living in socioeconomically deprived neighbourhoods were more likely to come into contact with mental health care services. Furthermore, the effect of neighbourhood socioeconomic deprivation on mental health service use was stronger in neighbourhoods with lower levels of social cohesion and trust between residents.

Thus, social cohesion and trust mitigated the effects of socioeconomic deprivation in children. This mitigating effect was also reported in section 3.5. Strong social cohesion and trust protected both against more serious mental health problems in all children and against lower levels of self-esteem in adolescents of higher educated parents. This aspect of social capital seems to protect against the deleterious effects of neighbourhood socioeconomic deprivation.

Research not included in the present thesis: Social capital effects in adults

Associations between neighbourhood-level social capital and quality of life of the parents of the family cohort have also been studied (Drukker et al., 2003), although not included in the present thesis.

The parents' questionnaire of the family cohort study included a quality of life questionnaire: the WHOQOL-BREF (WHO, 1998, De Vries and Van Heck, 1995). The WHOQOL-BREF questionnaire contains 25 questions, measuring overall quality of life and general health (hereafter overall quality of life); physical health (domain I); psychological health (domain II); social relationships (domain III); and the environmental domain of quality of life (domain IV). Respondents could answer the questions on 5-point Likert scales (e.g. fair to very good, or very unsatisfied to very satisfied). Higher scores indicated higher levels of quality of life for all domains.

Results from the baseline measurement of the family cohort study showed that both informal social control, and social cohesion and trust were associated with environmental quality of life (domain IV), and that this association remained after controlling for family socioeconomic status and other individual-level variables. In addition, social cohesion and trust was associated with physical health (domain I), but after controlling for confounders this association was statistically imprecise by conventional alpha (Drukker et al., 2003).

Results summarised

Almost all results of the MQoL indicated that neighbourhood-level social capital was associated with quality of life and subjective mental health, in both adolescents and adults. Informal social control seemed to be most important for 11 year old children's perceived mental health, behaviour, and boys school achievement, but this association was not found when the children were two to three years older (neither absolute levels nor changes since baseline).

In addition, social capital was not associated with adults' treated psychiatric morbidity. However, strong social cohesion and trust mitigated the risk-increasing effect of socioeconomic deprivation in children. This mitigating effect of social cohesion and trust was also found when analysing changes in self-esteem between baseline and follow-up. Furthermore, the MQoL results showed that social capital was not involved in the pathways of effects of income inequality or residential instability.

As described in our cross-national study, researchers should be cognisant of differences in the effects of social capital between different population groups within a city or between different cities in different countries or on different continents.

Mechanisms of social capital

Several pathways have been suggested to explain why social capital impacts on quality of life and subjective mental health. Firstly, both a more rapid diffusion of health information and the increased likelihood that healthy norms and behaviour are adopted, might be responsible for a better health in high social capital neighbourhoods (Kawachi et al., 1999b). However, non-healthy norms and behaviour can also spread more easily in these neighbourhoods. This contradicts a simple positive relationship between social capital and healthy outcomes. Secondly, as described in section 3.1 neighbourhood socioeconomic deprivation and social capital are strongly associated. Because socioeconomically deprived neighbourhoods usually are located in areas with environmental problems and pollution, the environmental pollution in these

neighbourhoods could be responsible for non-specific effects on health and quality of life. For example, three deprived neighbourhoods in Maastricht are located near an industrial area; two others near the highway and the railway. These five neighbourhoods were also low in social capital.

Finally, the association could be a result of psychological processes. Next to bonds within the family, bonds within the neighbourhood contribute to affective support and self-esteem, which may improve health (Kawachi et al., 1999b). In addition, persons who feel in control of their every day life are more likely to take control of their health (McCulloch, 2003). The last explanation seems the most plausible because it is in agreement with the follow-up results (section 3.5). These results showed that socioeconomic deprivation was only associated with self-esteem if social cohesion and trust in the neighbourhood was low. Moreover, the present thesis shows that social capital was associated with subjective measures of health and quality of life, but not with objective outcomes, and section 2.1 shows that individual perceptions of social capital mediated the association between socioeconomic deprivation and quality of life. This underlines the importance of a subjective (psychological) component in the mechanism.

5.2 Pressing issues

Context or composition?

Although social capital is a neighbourhood-level measure, measurement relies largely on the subjective information given by neighbourhood residents. The MQoL social capital measures were obtained from a sample of informants independent of the study sample. Nevertheless, answers of all informants are coloured by their individual characteristics. Using the PHDCN data, it has been shown that if the group of informants had a higher percentage of blacks or unmarried persons, were older, or had lower levels of socioeconomic status, neighbourhood levels of mistrust (an aspect of social capital) were higher, and controlling for these characteristics substantially changed neighbourhood-level estimates (Subramanian et al., 2003). However, individual socioeconomic and demographic composition provide the basis for social interactions in a neighbourhood (Subramanian et al., 2003) and, therefore, controlling for individual characteristics leads to overadjustment. Fortunately, the authors also reported that the raw social capital estimates and the adjusted estimates were highly correlated. Therefore, although the MQoL used raw estimates of social capital only, it is highly likely that the reported effects of social capital are valid.

Furthermore, contextual effects have been defined as true neighbourhood effects, and compositional effects have been based on the individual characteristics of the residents of the neighbourhood (Pickett and Pearl, 2001, Cullen and Whiteford, 2001). Thus, controlling for individual-level characteristics would result in estimating true contextual effects. However, compositional effects and contextual effects are interrelated and not mutually exclusive (Subramanian et al., 2003). People usually evaluate the neighbourhood before buying or renting a house. So, theoretically individuals with similar preferences and characteristics will concentrate in particular neighbourhoods (social selection). Thus, even after controlling for known individual characteristics, neighbourhood-level associations may still be (partly) compositional.

This also implies that there is a possibility that residual confounding leads to spurious results at the neighbourhood level, because of "omitted variable bias" (Leventhal and Brooks Gunn, 2000). To put it more simply, families moving into or not moving out of neighbourhoods may differ from their peers in other things than the confounders (e.g. in motivation, literacy etc). This makes it even more difficult to discriminate between true contextual effects and true compositional effects.

Thus, neighbourhood effects described in the present thesis are not related to the geography of the neighbourhood itself but to the people actually living there. Therefore, neighbourhood effects described in the present thesis have both contextual and compositional components and the present thesis was not designed to distinguish between these two. This means that policy interventions, based on our this research, should focus on the interaction between the neighbourhood on the one hand and the people living there on the other, rather than each separate component.

Level of measurement of social capital

The MQoL neighbourhoods were defined by the local authorities and are widely used and ecologically meaningful geographical units. However, neighbourhood residents most likely perceive different boundaries of their neighbourhood. Answers on the social capital items were significantly clustered within the defined neighbourhoods (chapter 3.1), warranting the inclusion of the neighbourhood level in the analyses. Because perceived

neighbourhoods were presupposed to be smaller than defined neighbourhoods, studying the level of perceived neighbourhoods could also be an option. However, until recently, no well-established method for using residents' definitions of neighbourhoods was available. Therefore, Coulton and colleagues conducted a pilot study, in which 140 residents of several neighbourhoods were asked to draw what they believed were the boundaries of their neighbourhood (Coulton et al., 2001). This pilot study reported clear variation between respondents. On average the size of perceived neighbourhoods in square miles was similar to the size of defined neighbourhoods (i.e. census tracts, 2000 to 4000 residents). However, although the size was similar, boundaries were not.

The social capital questions used in the present study ask about direct neighbours and problems in the own street. Therefore, perceived neighbourhoods in the MQoL were assumed to be much smaller than defined neighbourhoods and were assumed to comprise only (part of) the street of the respondent and perhaps one or two side streets. This assumption is very different from the results presented by Coulton and colleagues (Coulton et al., 2001). In order to verify this assumption, post hoc, the methods of Coulton et al. were applied in a relatively small convenience sample of colleagues and friends, living in the city of Maastricht (n=23). Respondents were asked to draw what they would define as their neighbourhood on a map when thinking of the social capital questions (informal social control, and social cohesion and trust). The maps showed that sizes of perceived neighbourhoods differed between the respondents, the smallest perceived neighbourhood being approximately 0.5% of the defined neighbourhood and the largest perceived neighbourhood being approximately 75%. Even the size of perceived neighbourhoods of two persons living in the same house could differ by a factor 3. Although the size of the perceived neighbourhoods varied, all respondents drew their perceived neighbourhood boundaries within the boundaries of a defined neighbourhood, except for three respondents of which one included a supermarket on the other side of the boundary, and one included a recreational area.

Thus, since boundaries differ per person, perceived neighbourhoods cannot be used when studying neighbourhood-level social capital, and information must be aggregated to defined neighbourhoods. This is methodologically valid because boundaries of perceived neighbourhoods generally do not cross the boundaries of defined neighbourhoods. In addition multilevel analyses showed that individual answers on informal social control, and social cohesion and trust were grouped within defined neighbourhoods, and most outcome measures also showed statistically significant variation at (defined) neighbourhood-level ($\sigma\mu 2$). In fact, the immeasurable perceived neighbourhoods were aggregated to larger neighbourhoods, and effects of social capital in smaller areas will be even larger than the reported association in the MQoL. Thus, aggregating data to neighbourhood level is the best way to study neighbourhood social capital.

There is one exception. Neighbourhood boundaries in the city centre follow relatively small streets, which, therefore, are less ecologically meaningful. Because none of the respondents lived near these boundaries, the boundaries in the city centre have to be excluded from the conclusion. Although it may be difficult to realise, it is recommended that future studies, using residents of neighbourhoods as informants on neighbourhood social capital, also include a question on the size and the boundaries of the perceived neighbourhoods. This will give more insight into the operational area of social capital.

Detrimental effects of social capital in minority groups

Various social capital researchers argued that higher levels of neighbourhood social capital may not be beneficial to every resident (McKenzie et al., 2002, Cullen and Whiteford, 2001). In fact, social capital may be deleterious to minority groups having other norms and values than the majority of their neighbours (McKenzie et al., 2002). When ties are strong, residents confirming to mainstream norms and values put less effort into contacts with outsiders and, arguably, the higher the trust within mainstream group members, the lower the trust between members of mainstream society and outsiders (Cullen and Whiteford, 2001). In agreement with that, it has been described that new immigrants entering a neighbourhood did not mix with the existing population (Flippen, 2001) and that minority children living in dissonant environments have lower levels of self-esteem than when living in a homogeneous consonant environment (Garcia Coll et al., 1996). Thus, the conclusion that social capital leads to a better health and quality of life is only valid for mainstream society members. Minority members are exposed to the negative side of social capital, which may lead to lower levels of health and quality of life.

More research specifically addressing minority groups is needed. Maastricht is a relatively small and homogeneous city. Although there will be some differences in norms and values within Maastricht neighbourhoods, future research on minority groups within neighbourhoods may be better done in larger more heterogeneous cities, such as a European capital or a North-American city, like Chicago.

Subdivisions of social capital in other research

Recently, researchers have broken down social capital into (1) structural and cognitive social capital; (2) horizontal and vertical social capital; and (3) bonding and bridging social capital. None of these subdivisions were relevant for the research described in the present thesis. Structural social capital is the actual existence of links between neighbours (what people do in terms of social relations) and it is beneficial because it can provide access to resources, which reduce the negative impact of life events (Harpham et al., 2002). Cognitive social capital, on the other hand, includes the individual perceptions of the social environment (what people feel in terms of social relations) (Harpham et al., 2002). These individual perceptions are associated with feelings of security and therewith also with quality of life and mental health (Harpham et al., 2004). Except for the cognitions of social capital described in section 2.1, the present thesis did not distinguish between these two forms of social capital. Social cohesion and trust is beneficial both because it enhances the accessibility of resources and because individuals feel more secure. Informal social control, theoretically, does not give access to resources. However, it can be seen as a resource itself (reducing the negative impact of life events and empowering groups).

Horizontal social capital describes bonds between persons of the same status, like residents of a neighbourhood (McKenzie et al., 2002). Vertical social capital is the link between policymakers and other persons higher in ranking on the one hand and neighbourhood residents on the other (McKenzie et al., 2002). The MQoL focussed on horizontal social capital in neighbourhoods. Vertical social capital is beyond the scope of the present thesis.

Some researchers also differentiated strong links between members of the same group (bonding social capital) from weak links between members of different groups (bridging social capital) (Cullen and Whiteford, 2001). The differentiation between bonding and bridging social capital is beyond the scope of the present thesis, because the MQoL

focussed on neighbourhood-level social capital. Bonds between neighbours probably are not as strong as between family and friends, and neighbourhood-level social capital is assumed to measure generalised trust or thin trust (Putnam, 1993). This is similar to bridging social capital, although neighbours can be seen as members of the same group.

Response

Unfortunately, the response in the community survey (section 2.1 and 2.2) was rather low (48%), but in section 2.1 it was reasoned that the association between socioeconomic deprivation and health-related quality of life may even be stronger than the results suggested. The response rate in the family cohort was 60% in parents (section 2.3) and 57% in children (at baseline). A higher response rate was expected because similar data collections of other Youth Health Care Divisions generally yield response rates around 80%. Maastricht residents may be somewhat tired of filling in questionnaires. Because of the presence of a university, the Maastricht population may be involved in many data collections. The structure of the data collection precluded sending an extra reminder. The apparent reluctance of the Maastricht population may also explain the low response in the community survey.

When analysing data of the children of the cohort (in the first four sections of chapter 3), data of their parents (e.g. socioeconomic status) were also included. Therefore, only 54% of the population could be used. However, except for the country of birth of the parents (The Netherlands, one or both born in a foreign country) parents of non-responding children did not differ from parents of responding children, and children of responding parents did not differ from the children of non-responding parents. Thus, it has been assumed that values were missing at random (MAR).

Sensitivity analyses were conducted to examine whether including the non-responding adolescents (with responding parents) would have yielded different results, using the data of section 3.1 (analysing associations between neighbourhood variables and adolescents' quality of life). This was done by multiple imputation of missing values on the CHQ outcome variables, and gender and grade retention of the adolescents, stratified by country of birth of the parents. The Stata hotdeck procedure replaces missing values in the relevant variables by values randomly sampled from complete lines in the same stratum. This procedure was used several times within a multiple imputation sequence since missing data are imputed stochastically rather than deterministically. Per regression model, one hundred imputation sequences were run, yielding 100 data sets in which the average risk difference coefficient of the neighbourhood variables were estimated within the hotdeck procedure. The results were similar to the results presented in section 3.1.

Other methodological issues

Unfortunately, effects of social capital and of socioeconomic deprivation could not be disentangled because of collinearity. In order to avoid this problem, future studies should stratify neighbourhoods by categories of socioeconomic deprivation and social capital and select the same number of neighbourhoods from each stratum.

Secondly, intra class correlations (ICC) were low in all multilevel regression models. However, most models did show statistically significant variation at neighbourhood level ($\sigma\mu 2$). In addition, neighbourhood researchers tend to analyse neighbourhood effects, even when the intra class correlation and the neighbourhood variation are low, and it is generally held that this is warranted, because effect sizes commonly viewed as large may translate into small proportions of variance (Raudenbush and Sampson, 1999).

Implications

Although neighbourhood effects on treated psychiatric morbidity rates over and above individual differences could not be proven, all MQoL results consistently showed that social capital is associated with individual quality of life in adolescents and adults. Maastricht policy makers could put more effort into enhancing social cohesion within (poor) neighbourhoods, next to interventions at the level of individual risk factors. However, increasing social capital will not be easy. In Boston, where community participation in the neighbourhood Villa Victoria declined over 2½ decades, policymakers hired professional community organisers to increase residents' participation again, but the project failed (Small, 2002). Policymakers can provide the facilities, but success depends on the motivation of the residents. The authorities can only stimulate and encourage the residents to visit a community centre for activities.

The results of the present thesis have been presented to a group of social workers. They were surprised to learn that social capital was lower in socioeconomically deprived neighbourhoods. Usually residents of poor neighbourhoods live on the streets, while the streets in affluent neighbourhoods are rather empty. On the other hand, this thesis shows that residents of poor areas do not trust each other as much as residents of affluent areas do. In addition, they probably are used to perceive children getting into mischief, which results in lower levels of informal social control. Moreover, it is possible that they prefer not to get involved with other people's children, because they expect problems with either the children or their parents. The Maastricht social workers saw a task for themselves in teaching parents to accept that neighbours interfere with the behaviour of their children, because children, when they grow older, widen their range of activities beyond the range of parental control. This acceptance can be a first step in the process to enhance informal social control in poor neighbourhoods.

Furthermore, the interaction effects of residential instability plead for a policy to improve the situation of residents of poor stable neighbourhoods. In these neighbourhoods helping to find job opportunities for the residents could support them to overcome the feeling of being trapped in a desperate and hopeless situation. Social workers could use several strategies (Granovetter, 1985). For example, they could cooperate with employment agencies in training and placement programs, advocate changes in small business regulations that put up barriers to legal entrepreneurship and self-employment. Secondly, they could stimulate social network factors of residents in job search networking in the traditional and internet economies (Granovetter, 1985).

Finally, as stated before, people usually evaluate a neighbourhood before buying or renting a house. So, theoretically individuals with similar preferences and characteristics will concentrate in particular neighbourhoods. In other words, similar types of persons tend to cluster in the same neighbourhood (social selection). This means that neighbourhood effects are not related to the geography of the neighbourhood itself, but to the people actually living there. So, interventions should focus on the interaction between the neighbourhood on the one hand and its residents on the other. Moving people to another neighbourhood in order to solve quality of life problems, is no solution from the point of view of the analyses described in the present thesis.

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Samenvatting

In het voorliggende proefschrift zijn de resultaten gepresenteerd van onderzoek naar de relaties tussen sociaal kapitaal (hoe de bewoners met elkaar omgaan) van de buurten van Maastricht en sociaal-economische status van de buurt (buurtSES) aan de ene kant en kwaliteit van leven en gebruik van de geestelijke gezondheidszorg (GGz-gebruik) aan de andere kant. De meeste resultaten zijn gebaseerd op gegevens van een cohort studie van kinderen uit groep 8 (bij aanvang van de studie) en hun ouders. Hieronder worden de artikelen uit de hoofdstukken 2, 3, en 4 kort samengevat.

Alle artikelen uit hoofdstuk 2 zijn bedoeld om sociaal kapitaal in een breder kader te plaatsten. In het eerste artikel werd beschreven dat een lagere buurtSES gerelateerd was aan een lagere ervaren gezondheid, geestelijke gezondheid en vitaliteit. Deze relaties werden echter "wegverklaard" als gegevens over "wat men van de buurt vindt" in de analyses werden meegenomen. Gezelligheid en sociale contacten bleken de sterkste intermediairen te zijn.

In het tweede artikel werd beschreven dat de relatie van buurtSES met kwaliteit van leven het sterkste was in buurten waar weinig verhuisd wordt. Dus hoewel een stabiele buurt zou kunnen zorgen voor meer sociaal kapitaal, blijkt het juist nadelig te zijn om in een arme stabiele buurt te wonen. Ten slotte is in hoofdstuk 2 beschreven dat inkomensongelijkheid in de Maastrichtse buurten geen relatie heeft met kwaliteit van leven.

In hoofdstuk 3 werd in het eerste artikel beschreven dat een lage buurtSES vaak (maar niet altijd) samengaat met minder sociaal kapitaal (in dit proefschrift gedefinieerd als informele sociale controle en sociale cohesie en vertrouwen). In dit artikel werd ook beschreven dat buurtSES en sociaal kapitaal een relatie hadden met kwaliteit van leven van de kinderen uit groep 8. Daarnaast bleek één aspect van sociaal kapitaal, informele sociale controle, een relatie te hebben met geestelijke gezondheid en gedrag van de jonge adolescenten.

De gegevens van de Maastrichtse 11-jarigen zijn vergeleken met gegevens uit een veel groter onderzoek dat gehouden werd in Chicago (PHDCN Project on Human Development in Chicago Neighborhoods). Het bleek dat buurtSES en sociaal kapitaal een relatie hadden met ervaren gezondheid bij de Maastrichtse adolescenten en bij de adolescenten uit Chicago met een Spaans-Amerikaanse etniciteit (Hispanic-Americans). Bij de andere adolescenten uit Chicago werden deze relaties niet gevonden.

Groei en schoolcijfers bleken niet geassocieerd te zijn met de buurtvariabelen (derde en vierde artikel van hoofdstuk 3). Dus de rol van de buurtfactoren is groter bij psychische uitkomsten dan bij fysieke. Echter, er was een uitzondering: bij de jongens had informele sociale controle een positieve relatie met schoolcijfers.

In het laatste artikel uit hoofdstuk 3 zijn resultaten uit de follow-up beschreven. De adolescenten waren toen 13 à 14 jaar oud. De buurtvariabelen bleken geen relatie te hebben met veranderingen in gezondheid en geestelijke gezondheid. Maar de *self-esteem* (gevoel van eigenwaarde) van de adolescenten in de buurten met een lage buurtSES die zelf ook een lage sociaal-economische status hadden was toegenomen, evenals de *self-esteem* van adolescenten uit de buurten met een hoge buurtSES die zelf ook een hogere sociaal-economische status hadden.

In hoofdstuk 4 zijn relaties tussen buurtfactoren en GGz gebruik bij kinderen en volwassenen beschreven. Bij volwassenen werd er wel meer zorg gebruikt in de armere

buurten en in de buurten met minder sociaal kapitaal, maar deze verschillen konden worden toegeschreven aan individuele confounders. Het GGz-gebruik van de kinderen bleek wel een relatie te hebben met buurtSES. Deze relatie was minder sterk in de buurten waar veel sociale cohesie en vertrouwen was.

Uit de meeste resultaten in dit proefschrift bleek dat sociaal kapitaal een relatie heeft met kwaliteit van leven en ervaren gezondheid, zowel bij adolescenten als bij volwassenen. Informele sociale controle leek vooral belangrijk voor de ervaren geestelijke gezondheid en het gedrag van 11-jarigen en voor de schoolprestaties van 11-jarige jongens.

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List of publications

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Curriculum Vitae

Marjan Drukker is op 11 november 1968 samen met haar zusje geboren in Velsen. In 1978 verhuisden zij met hun ouders naar Limburg. Na afronding van het Atheneum (B) in Heerlen (Grotius College) heeft Marjan GezondheidsWetenschappen gestudeerd aan de Universiteit Maastricht (destijds Rijksuniversiteit Limburg), afstudeerrichting Biologische Gezondheidkunde. Daarna heeft heeft ze de Postdoctorale Opleiding Epidemiologie gedaan aan de Vrije Universiteit in Amsterdam (EMGO).

Vanaf juli 1993 heeft Marjan tijdelijke banen gehad als epidemioloog bij diverse GGD's verspreid over heel Nederland (vervanger bij zwangerschapsverlof of projectmedewerker). In deze periode was zij onder andere werkzaam bij de GGD Westelijke Mijnstreek waar zij voor het eerst onderzoek deed naar buurten. In augustus 1998 is Marjan teruggekeerd naar Maastricht en maakte ze de overstap naar meer wetenschappelijk onderzoek. Eerst heeft zij een tijdelijke baan als Universitair Docent vervuld bij de capaciteitsgroep Epidemiologie van de Universiteit Maastricht. Vanaf januari 2000 werkte zij aan een promotieonderzoek bij de divisie Sociale Psychiatrie en Psychiatrische Epidemiologie van de Capaciteitsgroep Psychiatrie en Neuropsychologie. Sinds januari 2003 heeft ze ook een taak in het Psychiatrisch Casus Register Zuid-Limburg (voorheen MHCR) bij deze capaciteitsgroep.